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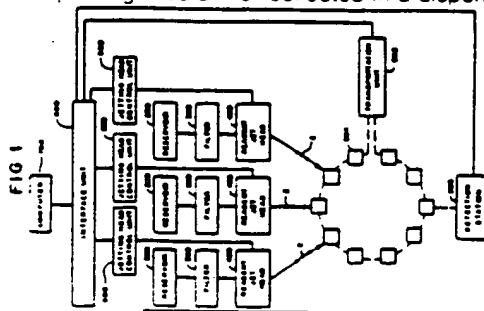
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11 Apparatus and process for reagent fluid dispensing and printing.

12 A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube, comprising an orifice at one end and a fluid receiving aperture at the other end, is concentrically mounted within a cylindrical piezo-electric transducer. The fluid receiving aperture is connected to a reservoir containing a selected reagent by means of a filter. The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer and the volume defined by the jetting tube to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer and the volume of the jetting tube to de-expand, thereby causing at least a substantially uniformly sized droplet of reagent fluid to be propelled through the orifice. The droplet may be directed to impact a printing medium or collected in a dispensing receptacle.



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## APPARATUS AND PROCESS FOR REAGENT FLUID DISPENSING AND PRINTING

### BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and process for dispensing and printing reagent fluids, wherein a transducer is used to propel small quantities of the fluid towards a positioned target.

Diagnostic assays often require systems for metering, dispensing and printing reagent fluids. In the case of metering and dispensing, such systems comprise both manual and automatic means. For purposes of practicality, the present background discussion will focus on the methods of metering and dispensing 100 micro-liter volumes or less.

The manual systems of metering and dispensing include the glass capillary pipet; the micro-pipet; the precision syringe; and weighing instruments. The glass capillary pipet is formed from a precision bore glass capillary tube. The pipet typically comprises a fire blown bulb and a tubular portion fire drawn to a fine point. Fluid is precisely metered by aspirating liquid through the tube into the bulb to a predetermined level indicated by an etched mark. The fluid may then be dispensed by blowing air through the tube.

The micro-pipet typically comprises a cylinder and a spring loaded piston. The travel of the piston is precisely determined by a threaded stop. The distance the piston travels within the cylinder and the diameter of the cylinder define a precise volume. The fluid is aspirated into and dispensed from the micro-pipet in precise quantities by movement of the piston within the cylinder.

The precision syringe generally comprises a precisely manufactured plunger and cylinder with accurately positioned metering marks. The fluid is introduced into and dispensed from the syringe by movement of the plunger between the marks.

Weighing techniques for dispensing fluids often simply involve weighing a quantity of fluid. The density of the fluid may then be used to determine the fluid volume.

Exemplary automatic metering and dispensing systems include the precision syringe pump; the peristaltic pump; and the high performance liquid chromatography (HPLC) metering valve. The precision syringe pump generally comprises a precision ground piston located within a precision bore cylinder. The piston is moved within the cylinder in precise increments by a stepping motor.

The peristaltic pump comprises an elastomeric tube which is sequentially pinched by a series of rollers. Often the tube is placed inside a semi-circular channel and the rollers mounted on the outer edge of a disc driven by a stepping motor. The movement of the rollers against the tubing produces peristaltic movement of the fluid.

The HPLC metering valve comprises a defined length of precision inner diameter tubing. The fluid is introduced into the defined volume of the tubing with the valve in a first position and then dispensed from the tubing when the valve is placed in a second position.

All of the above metering and dispensing systems have the disadvantage that the volumes dispensed are relatively large. Furthermore, these systems are also relatively slow, inefficient and comprise precision fitted components which are particularly susceptible to wear.

The printing of reagent fluids is frequently required in the manufacture of chemical assay test strips. Selected reagents are printed in a desired configuration on strips of filter paper. The strips may then be used as a disposable diagnostic tool to determine the presence or absence of a variety of chemical components.

Generally, to perform a chemical assay with a test strip, the strip is exposed to a fluid or a series of fluids to be tested, such as blood, serum or urine. In some instances, the strip is rinsed and processed with additional reagents prior to being interpreted. The precise interpretation depends on the type of chemical reactions involved, but it may be as simple as visually inspecting the test strip for a particular color change.

The manufacture of test strips generally involves either a manufacturing process or a blotting process. The blotting process is the simplest manufacturing method and permits most reagents to be applied without modification. A disadvantage of this process is that it is difficult to blot the fluids onto the test strip with precision.

The printing process will often involve any of three well known methods: silk screening; gravure; and transfer printing. The silk screening of reagents generally involves producing a screen by photographic methods in the desired configuration for each reagent to be printed. The screen is exposed under light to a preselected pattern and then developed. The areas of the screen which are not exposed to light, when developed, become porous. However, the areas of the screen which have been exposed to light remain relatively nonporous. The screen is then secured in a frame and the test strip placed below. The desired

reagent fluid, specially prepared to have a high viscosity, is spread over the top side of the screen. The reagent passes through the porous areas of the screen and onto the test strip. The test strip is then subjected to a drying process, specific to each reagent. Once the test strip is dry, it may be printed again using a different screen, pattern and reagent.

5 The gravure method of printing reagents comprises coating a metal surface with a light sensitive polymer. The polymer is exposed to light in the desired predetermined pattern. When developed, the polymer creates hydrophilic and hydrophobic regions. The reagent is specially prepared such that when applied to the metal it will adhere only to the hydrophilic regions. After the specially prepared reagent is applied, the test strip is pressed against the metal and the reagent is transferred from the metal to the test strip.

10 The transfer printing method comprises transferring the reagents from a die to the test strip in the desired pattern. The die is made with the appropriate pattern on its surface and then coated with the desired, specially prepared reagent. A rubber stamp mechanism is pressed against the die to transfer the reagent in the desired pattern from the die to the rubber stamp. The rubber stamp is then pressed against the test strip to transfer the reagent, in the same pattern, to the test strip.

15 Each of the above-mentioned reagent printing techniques has significant disadvantages. The most common disadvantage is the requirement that the reagents must be specially prepared. Additionally, if a variety of reagents are to be printed onto a single test strip, the strip must be carefully aligned prior to each printing. This alignment procedure increases the cost and decreases the throughput of the printing process. Moreover, a special die or screen must be produced for each pattern to be printed. A further disadvantage arises in that the above printing methods are unable to place reproducible minute quantities of reagent on the test strip.

It is an object of the present invention to provide a printing and dispensing method and apparatus which avoids these disadvantages.

25

#### SUMMARY OF THE PRESENT INVENTION

30 The present invention is directed to a reagent dispensing and printing apparatus and method, wherein the apparatus comprises a transducer operative to eject a substantially uniform quantity of reagent in a precise predetermined direction.

According to one preferred embodiment of the present invention used in dispensing reagent fluids, a jetting tube is concentrically located with a piezoelectric transducer. The jetting tube comprises an orifice at one end and a reagent receiving aperture at the other end. The receiving end of the jetting tube is connected to a filter which is in turn connected to a reservoir containing a selected reagent. A jetting control unit supplies an electrical pulse of short duration to the transducer in response to a command issued by a computer. The electrical pulse causes the volume defined by the jetting tube to expand by an amount sufficient to intake a small quantity of reagent fluid from the reservoir. At the end of the pulse duration, the transducer de-expands propelling a small quantity of the reagent fluid through the orifice and into a fluid receptacle. If desired, additional droplets may be deposited in the receptacle or the receptacle aligned with an additional jetting tube for receiving an additional reagent fluid.

45 An additional preferred embodiment of the present invention may be used for printing reagent fluids onto a print medium. In this embodiment, the jetting tube is aligned with the printing medium such that the propelled droplet impacts a precise position on the medium. The jetting tube or print medium may then be repositioned and another droplet expelled from the jetting tube. The process may be repeated until a desired configuration of the reagent fluid is printed on the medium.

One advantage of the present invention is that precise minute quantities of reagent fluid may be dispensed or printed in a reproducible manner. Additionally, the method and apparatus may be used to emit droplets of fluids having a wide range of reagent fluid viscosities and surface tensions. The reagents do not in general have to be specially adapted for use with the present invention.

50 The invention itself, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

55

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a schematic representation of a first preferred embodiment of the present invention showing the use of multiple jetting heads to meter and dispense reagent fluid.

5 FIGURE 2a is a perspective view of a first preferred embodiment of the jetting head of the present invention.

FIGURE 2b is a cut-away perspective view of the preferred embodiment of Fig. 2a taken along lines 2b-2b with the contact pins removed.

10 FIGURE 2c is a sectional representation of the preferred embodiment of Fig. 2a taken along lines 2c-2c.

FIGURE 2d is a sectional representation of the preferred embodiment of Fig. 2c taken along lines 2d-2d.

FIGURE 2e is a sectional representation of the jetting tube and transducer of the preferred embodiment of Fig. 2b taken along lines 2e-2e.

15 FIGURE 3 is a schematic representation of a second preferred embodiment operating in the drop on demand mode as a reagent printing system.

FIGURE 4 is a schematic representation of a third preferred embodiment operating in the continuous mode as a reagent printing system.

20 FIGURE 5a is a schematic representation of a portion of the jetting head control unit showing the LED strobe circuit.

FIGURE 5b is a schematic representation of a portion of the jetting head control unit showing the high voltage power supply circuit.

FIGURE 5c is a schematic representation of a portion of the jetting head control unit showing the print control circuit.

25 FIGURE 5d is a schematic representation of a portion of the jetting head control unit showing a portion of the print pulse generator.

FIGURE 5e is a schematic representation of a portion of the jetting head control unit showing an additional portion of the pulse generator.

30 FIGURE 6a is a perspective view of a second preferred embodiment of the jetting head of the present invention.

FIGURE 6b is an exploded view of the preferred embodiment of Fig. 6a.

FIGURE 7 is a sectional representation of a third preferred embodiment of the jetting head of the present invention.

35 FIGURE 8 is a sectional view of a symmetrical portion of a fourth preferred embodiment of the jetting head of the present invention.

FIGURE 9 is a graph of the drop mass of the emitted droplets as a function of emission frequency for several fluid viscosities.

FIGURE 10 is a graph of the velocity of the emitted droplets as a function of frequency for several fluid viscosities.

40 FIGURE 11 is a graph of the total weight of fluid emitted as a function of the number of emitted droplets for a given fluid.

## DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

45 Turning now to the drawings, Fig. 1 shows a schematic representation of a first preferred embodiment of a reagent dispensing system generally represented as reference numeral 30. The dispensing system 30 comprises a plurality of reagent fluid reservoirs 200, a plurality of filters 300, a plurality of reagent jetting heads 400, a plurality of jetting head control units 500, an interface unit 600, a computer 700, transportation unit 902, a plurality of fluid mixing cells 904 and a detection station 906.

50 The reservoir 200 holds a selected quantity of reagent fluid for dispensing. The reservoir 200 is maintained at atmospheric pressure by suitable means such as an atmospheric vent. The reagent fluid is transferred from the reservoir 200 through the filter 300 to the reagent jetting head 400. The filter 300 is placed between the reservoir 200 and the jetting head 400 to ensure that any particular foreign matter in the reagent fluid is trapped before entering the jetting head 400.

55 The plurality of jetting heads 400 and the detection station 906 define a processing path. Each jetting head 400, which is described in detail below, ejects uniformly sized droplets 2 of reagent fluid. The droplets 2 are propelled, with controlled velocity and direction, towards a selecting mixing cell 904 positioned along

the processing path by the transportation unit 902. The mixing cells 904 are comprised of non-reactive material and function as minute holding tanks for the dispensed reagent fluid.

The plurality of jetting heads 400, shown in Fig. 1, are positioned sequentially along the processing path. Alternately, some or all of the plurality of jetting heads 400 may be positioned with respect to the transportation unit 902 such that the heads 400 direct the droplets 2 into a selected mixing cell 902 simultaneously.

The jetting heads 400 and the transportation unit 902 are controlled by the computer 700. The computer 700 issues commands to an interface unit 600 which is electrically connected to the transportation unit 902 and to the jetting head control unit 500. The interface unit 600 is of conventional design and is used to control the transfer of information between the computer 700 and the jetting control unit 500. The interface unit 600 is also used to control the transfer of information between the computer 700 and the transportation unit 902.

A first embodiment of the reagent jetting head is shown in Figs. 2a - 2e and generally represented by numeral 400. The jetting head 400 comprises a two piece symmetrical housing 402, 404. The housing 402, 404, when assembled, is adapted to form an orifice aperture 406, an air vent and reagent supply channel 410 and a transducer chamber 403, shown in Fig. 4b. Four screws 408, adapted to respective housing screw apertures 416, hold the housing 402, 404 in an assembled configuration.

The jetting head 400 further comprises a jetting tube 432, a piezo-electric transducer 434 and a reagent fluid supply tube 430. The jetting tube 432 defines a tapered orifice 433 at one end and a fluid receiving aperture 431 at the other end for expelling and receiving fluid, respectively. The piezo-electric transducer 434 is cylindrically shaped and secured concentrically about the mid-region of the jetting tube 432 with epoxy or other suitable means.

The piezo-electric transducer 434, shown in Fig. 2e, defines a first and second end and comprises a section of cylindrically shaped piezo-electric material 435. An inner nickel electrode 437 covers the inner surface of the cylinder 435. The electrode 437 wraps around the first end of the cylinder 435 a sufficient distance to enable electrical connection external to the cylinder 435.

A second nickel electrode 436 covers the majority of the outer surface of the cylinder 435. The second electrode is electrically isolated from the first electrode 437 by an air gap at the face of the second end of the cylinder 435 and by an air gap on the outer surface of the cylinder 435 near the first end. When an electrical pulse is applied to the first and second electrodes 437, 436 a voltage potential is developed radially across the transducer material 435. The voltage potential causes the radial dimensions of the transducer 435 to change, which causes the volume defined by the transducer 434 to also change.

The jetting tube 432 is positioned in the transducer chamber 403 such that the receiving end 431 extends beyond the rearward end of the transducer 434. The receiving end 431 of the jetting tube 432 is inserted into one end of a reagent supply tube 430. The supply tube 430 is sealingly held to the jetting tube 432 by concentric teeth 412 formed by the housing sections 402, 404. The teeth 412 not only seal the supply tube 430 to the jetting tube 432, but, also, seal the supply tube 430 to the housing 402, 404.

The second end of the supply tube 430 passes through the channel 410 and into a reagent reservoir 200. The reservoir 200 contains the reagent fluid to be dispensed by the jetting head 400. As the reagent fluid is dispensed, air is supplied to the reservoir 200 through the channel 410 to prevent the creation of a vacuum in the reservoir 200. The reservoir 200 is releasably attached to the housing 402, 404 and held in place by frictional forces. A reservoir cap 202 is flexibly attached to the reservoir 200 and adapted such that the cap 202 may be used to secure the opening in the reservoir 200 when the reservoir 200 is disengaged from the housing 402, 404.

The position of the jetting tube 432 defines the horizontal plane of the jetting head 400. The jetting tube 432 and the transducer 434 are held in a pre-defined vertical relationship with respect to the housing 402, 404 by means of two upper vertical alignment pins 418 and two lower vertical alignment pins 418. The two upper vertical alignment pins 418 extend horizontally from the housing section 402 into the transducer chamber 403. Similarly, the two lower vertical alignment pins 418 extend horizontally from the housing section 404 into the transducer chamber 403. Each vertical alignment pin 418 is formed integrally with the respective housing sections 402, 404.

The jetting tube 432 and the transducer 434 are held in a predefined horizontal relationship with respect to the housing 402, 404 by means of four horizontal alignment pins 424. Two of the horizontal alignment pins 424 extend horizontally from the housing section 402 approximately midway into the transducer chamber 403. Similarly, two of the horizontal alignment pins 424 extend horizontally from the housing section 404 approximately midway into the transducing chamber 403. Each horizontal alignment pin 424 is formed integrally with the respective housing section 402, 404. The alignment pins 418, 424, sealing teeth 412 and orifice aperture 406 are aligned and adapted to hold the jetting tube 432 and transducer 434 such

that the orifice 433 of the jetting tube 432 extends into the orifice aperture 406.

An electrical transducer activation pulse is supplied to the piezo-electric transducer 434 from the jetting head control unit 500 by means of two contact pins 422. A quantity of fluid will be dispensed from the jetting tube for each applied activation pulse. The activation pulse can be produced by a variety of conventional circuits or commercially available units. Therefore a detailed description of such a circuit will not be provided. However, a circuit for producing a series of activation pulses is provided in the description of the printing embodiment below. Due to the differing constraints involved in dispensing and printing, the circuit in the printing embodiment is not required to produce only a single pulse. However, one skilled in the art could, if desired, modify the circuit to produce a single pulse on demand for use in the dispensing embodiment.

Each contact pin 422 defines an enlarged head 423 which is adapted to contact the respective first and second electrodes 437, 436 located on the outer surface of the transducer 434. Two contact pin holders 414, integral with the housing 402, 404, are positioned to hold the respective contact pins 422 under the pin heads 423 such that each pin head 423 electrically engages the appropriate electrode 437, 436 of the transducer 434. Two contact pin engaging posts 420 extend from the housing 402, 404 opposite the contact pin holders 414 to engage and hold the contact pins 422 against the contact pin holders 414. The ends of the contact pins 422 opposite the pin heads 423 extend through the housing 402, 404 by means of contact pin apertures 421. Since the housing sections 402, 404 are formed symmetrically to one another, the contact pins 422 may be optionally attached above the transducer 434.

In operation, the reservoir 200 containing reagent fluid is fastened to the jetting head 400 such that the fluid supply tube 430 extends into the reagent fluid. The filter 300 may be fitted to the free end of the supply tube 430 or positioned inside the reservoir 200. Air is supplied through the channel 410 around the supply tube 430 to prevent the reservoir 200 from falling below atmospheric pressure. The air is prevented from entering around the supply tube 430 and into the transducer chamber 403 by the seal created between the sealing teeth 412 and the supply tube 430. The jetting tube 432 may be primed by slightly pressurizing the reservoir 200 to cause the reagent fluid to travel through the supply tube 430 and into the jetting tube 432. Once primed, the fluid is prevented from substantially withdrawing from the jetting tube 432 by the surface tension of the reagent fluid at the orifice 433.

The transducer activation pulse is conducted to the contact pins 422 of the jetting head 400. The contact pins 422 communicate the high voltage pulse to the electrodes 437, 436 of the transducer 434 with polarity such that the concentrically mounted transducer 434 expands. The rate of expansion is controlled by the rise time of the high voltage pulse which is preset to generate a rapid expansion. The expansion of the transducer 434 causes the jetting tube 432, which is epoxied to the transducer 434, to also expand. The expansion of the tube 432 generates an acoustic expansion wave interior to the tube 432 which travels axially towards the orifice 433 and towards the fluid receiving aperture 431. When the expansion wave reaches the orifice 433, the reagent fluid is partially drawn inwardly. However, the surface tension of the fluid acts to inhibit substantial inward fluid movement.

When the expansion wave reaches the end 431 of the tube 432, the expansion wave is reflected and becomes a compression wave which travels towards the center of the piezo-electric tube 434. The high voltage pulse width is adapted such that when the reflected compression wave is beneath the piezo-electric tube 434, the high voltage pulse falls, resulting in a de-expansion of the transducer 434 and the jetting tube 432. This action adds to the existing acoustic compression wave in the interior of the jetting tube 432. The enhanced compression wave travels toward the orifice causing reagent fluid to be dispensed from the tube 432. The fluid is propelled from the orifice 433 as a small droplet 2 and deposited in the selected mixing cell 904 positioned by the transportation unit 902. One droplet 2 is dispensed for each transducer activation pulse. This mode of dispensing is referred to as the drop on demand mode.

In some instances, the droplet 2 may be accompanied by at least one smaller satellite droplet. However, even if satellite droplets are present, the volume and velocity of the reagent droplets 2 are highly reproducible. This reproducibility allows for precise dispensing of uniform, controllably sized droplets 2 of reagent fluid into the mixing cell 904.

The droplets 2 of reagents impact the mixing cell 904 with sufficient force and volume to cause fluidic mixing of the reagents. Once the desired amounts of the selected reagents are deposited in the selected mixing cell 904, mixing cell 904 is transported to the detection station 906 where the mixed reagents may be extracted for use or analyzed for assay results.

The dispensing system 30 provides numerous advantages based upon the ability of the reagent jetting head 400 to rapidly and reproducibly eject uniform quantities of a wide range of reagents. The reaction times of some chemical processes are dependent upon the volume of the reagents used. The ability of the dispensing system 30 to dispense such minute amounts of reagents thereby reduces the processing time

of certain chemical assays. Furthermore, some chemical assays require a wide range of dilution ratios. Many conventional dispensing systems are unable to dispense the reagents in volume small enough to make the desired assay practical. The dispensing system of the present invention overcomes this disadvantage.

5 In addition to dispensing reagent fluids, certain embodiments may be used for precision printing of reagents onto a printing medium such as filter paper to produce an assay test strip. A printing system 10 using the present invention is represented in Fig. 3. Structure similar in form and function to structure described above will be designated by like reference numerals. The printing system 10 comprises a reagent fluid reservoir 200, a filter 300, a reagent jetting head 400, a jetting head control unit 500, an  
10 interface 600, a computer 700, and an x-y plotter 800.

The x-y plotter 800 is a commercially available pen plotter, mechanically modified in a conventional manner such that the pen is replaced with the jetting head 400. The general operation and structure of the plotter 800 will not be described in detail. The plotter 800 accepts commands from the computer 700 thru a standard RS-232 serial interface contained within the interface unit 600. The plotter 800 processes the  
15 commands and produces control signals to drive an x-axis motor (not shown) and a y-axis motor (not shown). The x-axis motor is used to position the jetting head 400 and the y-axis motor is used to position a drum (not shown) to which the printing target 1 is attached.

The plotter 800 produces a pen down signal PENDN. This signal is applied to the control unit 500 and indicates that the plotter 800 is ready to begin a printing operation.

20 The control unit 500 also receives control signals from the interface unit 600. These signals include signals HIGHER\*, LOWER\* to control the magnitude of the pulse applied to the transducer 434; a reset signal RST to reset the control unit 500; and a series of print signals PRT\*. The generation of these signals will not be described in detail since their production is performed by the conventional interface unit 600.

The jetting head 400 and fluid supply system 200, 300 are initialized and operate substantially as  
25 described above. The jetting head control unit 500, shown in Figs. 5a - 5e comprises a print control circuit 510, a pulse generator 530, a high voltage supply 540, and a strobe pulse generator 560. The control unit 500 also comprises a power supply. However, since the power supply is of conventional design it will not be shown or described in detail.

The print control circuit 510 receives the pen down signal PENDN from the plotter 800 and comprises a  
30 transistor Q100, a one-shot circuit U100, two NAND-gates U101, U102, a line decoder multiplexer U107 and four inverters U103-U106. The pen down signal PENDN is applied to the base of the transistor Q100 by resistors R100, R101 and diode D100. The emitter of transistor Q100 is tied to ground and the collector is connected to the +5 volt supply by resistor R102.

The one-shot U100 comprises inputs A, B and an output Q. The B input of the one-shot U100 is  
35 connected to the collector of the transistor Q100 and the A input is tied to ground. The time period of the pulse produced by the one-shot U100 is determined by a resistor R104, a variable resistor R105 and a capacitor C100. The output Q of the one-shot U100 is combined with the collector output of the transistor Q100 by the NAND-gate U101 and then inverted by the NAND-gate U102. The circuit is operative to produce an adjustable delay in the application of the pen down signal PENDN to the control unit 500.

40 The line decoder U107 is circuited to function as a 3 input AND-gate. The output of the NAND-gate U102 is applied to the first input of the decoder U107; the print signal line PRT\* comprising a series of pulses from the interface unit 600 is applied to the second input; and a jetting head ON/OFF signal from switch S1 is applied to the third input. The inverter U106 inverts the output of the line decoder U107 to generate the print control signal PRT\* and the inverters U103-U105 invert the control signals LOWER\*,  
45 HIGHER\*, and RST signals, respectively.

The high voltage supply 540, shown in Fig. 5b, provides +175 volts DC to produce a maximum pulse  
50 of +150 volts peak to peak at the reagent jetting head 400. The high voltage supply 540 comprises differential amplifier U12 and transistors Q1, Q2, Q13, Q14. A stable reference voltage of -2.5 volts DC is produced at the junction of a resistor R13, connected to the -15 volt supply, and a diode CR6, connected to ground. The reference voltage is combined with a resistor R14 to produce an adjustable, stable voltage reference for the amplifier U12. The reference voltage is applied to the inverting input of the amplifier U12 through a resistor R11. The noninverting input of the amplifier U12 is connected to ground by a resistor R12. The amplifier U12, in combination with a feedback resistor R10, produces an output signal proportional to the difference of the voltage reference signal and the ground potential.

55 The output of the amplifier U12 is applied to the base of the transistor Q2 whose collector is connected to the +15 volt supply. The signal produced at the emitter of the transistor Q2 is applied to the base of the transistor Q1 through resistors R8, R6, R5, a transformer L1 and diodes CR4, CR2, CR1. The emitter of the transistor Q1 is connected to ground and the collector is connected to the -15 voltage supply through the



transformer L1. A diode CR3 connects the collector of the transistor Q1 to the junction of the resistor R5 and the diode CR4. The transistor Q1 is biased for proper operation by resistors R7, R6, R5. The resistor R7 and a capacitor C22 connect the junction of the resistor R8, R6 to the +15 voltage supply.

The transistor Q1 and the transformer L1 form a "flyback" blocking oscillator. Any increase in current supplied by the transistor Q1 produces an increase in energy transferred through the secondary winding of the transformer L1 and diode CR5. Therefore, an increase in current supplied by the transistor Q1 results in an increase in power available to the high voltage output. The diodes CR1-CR4 form a "Baker clamp" which prevents transistor Q1 from saturating. The clamp thereby avoids transistor storage time.

The diode CR5 is connected to a multiple pi filter formed by the inductors L3, L2, capacitors C24, C21, C41 and resistors R29. The multiple pi filter attenuates ripple and switching spikes in the signal supplied to the transistor Q13 which produces the high voltage output  $V^{++}$ . A resistor R64 connects the base of the transistor Q13 to the emitter and to the resistor U29. The base is also connected to the collector of the transistor Q14 by a resistor R65. The base of the transistor Q14 is connected to the +15 volt supply by a resistor R67 and to ground by a resistor R66. The emitter of the transistor Q13 provides a signal HV SENSE which is fed back to the inverting input of the amplifier U12 through a resistor R9. The high voltage output  $V^{++}$  is produced at the collector of the transistor Q13. The proper biasing of the transistor Q13 is provided by resistor R64 and the biasing circuit comprising the transistor Q14, resistors R67, R66, R65.

The pulse generator 530, shown in Figs. 5d, 5e, comprises an opto-isolator U18, a one-shot U23, a digital to analog (D/A) converter U30 and two binary counters U24, U25. The pulse generator 530 accepts control signals PRT\*, LOWER\*, HIGHER\*, RST and produces the activation pulse which is applied to the transducer 434. In normal operation, the PRT\* control signal is supplied to the opto-isolator U18 by a jumper JMP between contact points E5, E6. The opto-isolator U18 is of conventional design and comprises a light emitting diode (LED) circuit and a photo-element circuit. A resistor R15 operates as the load resistor for the LED circuit of the isolator and a capacitor C25 suppresses transient noise on the voltage supply to the isolator U18. The output of the isolator U18 is applied to one input of the one-shot U23 whose time constant is adjustably determined by resistors R38, R25 and a capacitor C30. The pulse from the non-inverting output of the one-shot U23 is fed to the base of a transistor Q9. A resistor R39 sets the approximate base current of the transistor Q9 which is used as a level shifter for converting the CMOS signal level to the +15 volt DC signal level.

The control of the rise and fall rates of the pulse generator 530 is accomplished by directing a pair of current source transistors Q11, Q12 to charge and discharge a capacitor C57. The transistor Q11 is operative as a source of current and the transistor Q12 is operative as a sink for current. A transistor Q10 controls the level of the current by applying an appropriate bias current through a resistor R56 to the base of the transistor Q11. The biasing of the transistors Q11, Q12 is critical to the proper rise and fall rates. Therefore precision voltage references CR13, CR15 are used to provide respective bias reference voltages. A temperature compensation network is formed from zener diodes CR14, CR16 and resistors R55, R54 to maintain stable operation of the transistors Q11, Q12, respectively. The variable resistors R49, R52 may be used to adjust the fall time and rise time, respectively, of the output pulse applied to the reagent jetting head 400. A plurality of resistors R45, R46, R47, R48, R49, R51, R52, R53, R56, R57, R58 are used to properly bias the transistor Q10, Q11, Q12 and capacitors C55, C60 are circuited to maintain stability of the circuit.

The impedance of the output stage of the rise and fall circuitry Q10, Q11, Q12 is very high. With such a high impedance, circuit elements attached to the capacitor C57 could affect the linearity of the rise and fall time constants. Therefore, an FET input operational amplifier U32 is used as an impedance interface. The amplifier U32 is configured in the noninverting mode and circuited with capacitors C58, C59 for stability.

The output of the amplifier U32 is applied to an inverting amplifier U31 by means of a resistor R62. The amplifier U31 inverts and conditions the pulse control signal with the aid of resistors R59, R60. Resistors R61, R63, connected to the -15 voltage supply, provide a means for adjusting the DC level offset of the amplifier U31 output signal. Capacitors C51, C52 are connected to enhance the performance and stability of the circuit.

The output of the amplifier U31 is applied by means of a resistor R41 to the positive voltage reference signal input  $REF(+)$  of the D/A converter U30. The negative voltage reference signal input  $REF(-)$  is tied to ground by a resistor R40. The D/A converter U30 produces output signals IOUT, IOUT\* which are proportional to the difference between the positive and negative voltage reference signal inputs  $REF(+)$ ,  $REF(-)$ . Capacitors C48, C49, C50 are connected to the D/A converter U30 to enhance stability.

The D/A converter outputs IOUT, IOUT\* are also proportional to an 8-bit binary value applied to inputs B1-B8. The binary value is supplied by the counters U24, U25 which are controlled by the function signals LOWER\*, HIGHER\* and RST. The LOWER\* signal and the HIGHER\* signals are applied to the count up and

count down inputs CU, CD of the counter U24 by means of opto-isolators U19, U20. The carry and borrow outputs CY, BR of the counter U24 are connected with the count up and count down inputs CU, CD of the counter U25. The reset inputs RST of both counters U24, U25 receive the RST signal by means of an opto-isolator U21. Resistors R16, R17, R18 are used as load resistors for the LED circuits of the isolators U19, U20, U21 and capacitors C26, C27, C28 are used to enhance the stability of the isolator circuits.

The counters U24, U25 may optionally be preloaded to the selected 8-bit binary value through input lines TP0-TP7. The input lines TP0-TP7 are normally biased to the logical high signal state by resistive network U22. The selected binary value is loaded into the counters U24, U25 by pulling the respective inputs TP0-TP7 low and applying an external, active low, load signal EXT LOAD to pin TP8. The load signal pin TP8 is connected to the load inputs LOAD of the counters U24, U25 and conditioned by a clipping circuit comprised of diodes CR9, CR10 and a pull-up resistor of the resistor network U22.

The noninverted and the inverted outputs IOUT, IOUT<sup>\*</sup> are connected to the inverting and noninverting inputs of a differential amplifier U29. The output of the amplifier U29 is fed back to the inverting input by a resistor R50. The amplifier U29 converts the current output of the D/A converter U30 to a voltage output. Capacitors C56, C47 are provided to enhance circuit stability.

The output of the amplifier U29 is applied to the noninverting input of the amplifier U28. The output of the amplifier U28 is fed back to the inverting input by means of a capacitor C46 and a resistor R37. The inverting input is also connected to ground by a resistor R36. To enhance the frequency response of the amplifier U28, a resistor R43 and a capacitor C54 are connected between the frequency compensation input FC and ground. An adjustable DC offset is provided by connecting the output offset inputs OF, OF with a variable resistor R42. The wiper of the resistor R42 is connected to the high voltage power supply output V<sup>+</sup>.

The output of the amplifier U28 is also connected to the base of a transistor Q4 and through diodes CR11, CR12 to the base of a transistor Q7. The transistor Q4, Q7, Q3 and resistors R30-R35 form an output circuit capable of driving high capacitive loads at high slew rates and wide bandwidth. The variable resistor R31 may be used to set the maximum current through the bias network R30, R33 by measuring the voltage drop across resistor R35.

The strobe generator 560 produces a strobe pulse and comprises transistors Q101-Q105 and a one-shot circuit U108. The strobe intensity is determined by the circuit comprising the transistors Q101-Q104 and resistors R109-R115. The circuit is connected to the anode of the LED 900 and receives two inputs from the interface unit 600 to produce four levels of light intensity in the LED 900.

The activation and duration of activation of the LED 900 is determined by the one-shot U108 and the transistor Q105. The one-shot U108 comprises inputs A, B and an output Q. The strobe signal STROBE is applied to the B input from the interface unit 600. The duration of the one-shot U108 output pulse is controlled by the adjustable RC network R107, R108. The output Q is applied to the base of the transistor Q105 by resistor R108. The collector of the transistor Q105 is connected to the cathode of the LED 900 to draw current through the LED 900.

The computer 700, control unit 500 and plotter 800 must be initialized. The initialization of the computer 700 and the plotter 800 will not be discussed since these units are of conventional design and operation.

To initialize the jetting head control unit 500, the computer 700 directs the interface unit 600 to issue a reset command. The reset signal RST is conducted to the control unit 500 whereupon the counters U24, U25 are cleared. The computer 700 then retrieves from its memory, or by conventional operator input, the desired digital setting for the D/A converter. This setting may also be calculated from data and may be tailored to specific sizes of jetting heads 400 or reagent fluids. The computer 700 then issues a series of commands, through the interface unit 600, to increment or decrement the counters U24, U25 to correspond to the desired binary setting. If the command directs that the counters are to be raised, then the HIGHER<sup>\*</sup> signal is applied through the opto-isolator U20 to the count up CU input of the counter U24. Similarly, if the command directs that the counters are to be lowered then the LOWER<sup>\*</sup> signal is applied through the opto-isolator U19 to the count down CD input of the counter U24. Since the carry and borrow outputs CY, BR of the counter U24 are connected to the count up and count down inputs CU, CD, respectively, of the counter U25, the digital setting applied to the D/A converter U30 may range from 0 to 255. Alternately, the counters U24, U25 could be initialized to a desired setting by loading the binary value on the lines TP0-TP7 and strobing the EXT LOAD line.

Once the control unit 500 and the plotter 800 are initialized, the printing cycle may begin. The computer 700 issues a command to the interface unit 600 to produce the series of PRT<sup>\*</sup> signal pulses. The computer 700 then commands the plotter 800 to print, for example, a line along a selected path. The plotter 800 positions the jetting head 400 and target 1 and issues the pen down signal PENDN. The signal is delayed by the print control circuit 510 to ensure that the target 1 is properly positioned. At the expiration of the

delay, the signal is AND'd with the closed enable switch S1 and the series of print pulses PRT\*. The result of the AND operation is the application of the PRT\* pulses to the pulse generator circuit 530.

The PRT\* signal is applied through the jumper JMP to the opto-isolator U18 and then to the one-shot U23. The one-shot U23 produces a pulse signal which is then converted from CMOS signal levels to the 15 volt DC signal level by the transistor Q9. The rise and fall circuitry comprising Q10, Q11, Q12 converts the square wave pulse into a pulse having the rise and fall characteristics preset by the resistors R49, R52. The conditioned pulse is then amplified by the amplifier U32 and applied to the amplifier U31.

The amplifier U31 converts the polarity of the conditioned pulse to that acceptable by the D/A converter U30 and supplies an adjustable DC offset. The DC offset is used to counteract possible distortion attributable to the amplifier U31. The distortion arises in that, for the amplifier U31 to be adequately responsive, a small degree of current must flow through the resistor R41. This current creates an offset condition at the output of the amplifier U29 which is then scaled by the D/A converter U30 in correspondence with the binary data. The resistor R63 allows a small amount of current to be applied to the amplifier U31 to control the offset voltage attributable to the current flowing through the resistor R41.

The D/A converter U30 scales the difference between the inputs REF(+), REF(-) using the binary data supplied to input lines B1-B8 to produce a current output pulse IOUT and a current inverted output pulse IOUT\*. The two outputs IOUT, IOUT\* are fed to the amplifier U29 which convert the current outputs into a single voltage output. The scaled, conditioned pulse is then applied to the output circuit comprising the amplifier U28 and the transistors Q3, Q4, Q5, Q6, Q7. The circuit produces a high voltage pulse with the aforementioned rise and fall characteristics to drive the piezo-electric transducer 434.

The high voltage pulse is applied to the transducer 434 and causes a droplet 2 of fluid to be propelled onto the target 1. Since the pen down signal PENDN is still applied, additional droplets 2 are produced from the jetting head 400. The plotter 800 moves the jetting head 400 and target 1 along the desired path during the emission of the droplets 2 to produce the desired printed line. When the printing is complete, the plotter 800 removes the pen down signal PENDN and the droplet emission stops. Of course it should be understood that dots, circles and the like could be produced by appropriate positioning of the target 1 and jetting head 400.

The size and uniformity of the droplets 2, as well as the presence of any satellite droplets, may be observed with the aid of the scope 950 and the LED 900. The scope 950 and the LED 900 are positioned such that the droplets 2 pass between the scope 950 and the LED 900 and within the focal range of the scope 950. The strobe pulse when applied to the LED 900 causes the LED 900 to momentarily flash. The timing of the activation and the width of the pulse may be adjusted such that the flash occurs when the fluid, expelled in response to the high voltage pulse, is between the scope 950 and the LED 900. The dispensed quantity of fluid may then be observed in flight or at or near the moment of separation from the orifice 433. Corrections based on the observation may then be made to the system 10.

Since each droplet 2 is small in volume, the droplet 2 may be rapidly absorbed by the target 1, thereby allowing rapid and precise placement of a variety of reagents on the target 1 with reduced drying time and reduced potential of fluidity mixing. In addition, the ability to place small droplets 2 in a precise manner enables the target 1 to be printed in a high density matrix with a variety of reagents as isolated matrix elements.

In some printing applications, particularly when printing fluids of flow viscosity and surface tension, it may be desirable to force the fluid through the jetting tube 432 under pressure and allow the vibrations produced by the transducer 434 to break the emitted fluid stream into precise droplets 2. Under this mode of printing, the emission of droplets 2 can not be stopped by cessation of the transducers activation pulse. It is therefore necessary to prevent fluid emission by other means. One preferred means of momentarily stopping emission of the droplets is shown schematically in Fig. 4. In this arrangement, structure similar to structure represented in Fig. 3 in form and function, is represented by like reference numerals.

The arrangement, generally represented by the numeral 20, includes a closed reagent recirculation system comprising a normally close three way valve 970, a sump 960 and a recirculation pump 980. In the continuous mode, the reagent fluid is forced out the orifice 433 by hydraulic pressure and broken into a series of substantially uniform droplets 2 by movement of the transducer 434. A regulated, filtered air supply 100 is used to pressurize the reagent fluid reservoir 200. The reagent fluid within the reservoir 200 may optionally be agitated by a magnetic stirrer unit 990. This is especially useful for reagent fluids comprising suspended particles.

The three-way valve 970 comprises a common channel, a normally open channel and a normally closed channel. The fluid is forced through the filter 300 and applied to the normally closed channel of the valve 970. When the normally closed channel is closed, the normally open channel of the valve 970 functions as a vent for the reagent jetting head 400. The common channel is connected to the reagent supply tube 430

of the jetting head 400. The reagent supply tube 430 is also connected to the sump 960.

In operation, the normally closed channel is opened by an appropriate signal supplied by the computer 700 which also closes the normally open channel. When the normally closed channel is opened, fluid is permitted to pass to the sump 960 and to the jetting head 400. The sump 960 collects the reagent fluid not transferred to the jetting head 400. The sump 960 supplies the collected fluid to the inlet side of the recirculating pump 980 which returns the fluid to the reservoir 200. The returned fluid is then mixed with the contents of the reservoir 200 and is available for recirculation.

When operating in the continuous mode, rather than interrupt the continuous stream of print pulses to the jetting head 400, the printing may be momentarily stopped by closing the normally closed channel of the valve 970. The closing of the normally closed channel stops the flow of reagent fluid to the jetting head 400 and allows the jetting head 400 to vent to atmospheric pressure. With the fluid supply blocked, the transducer 434 is unable to expel further droplets 2. Thus, if positioning of the target 1 by the plotter 800 requires a longer time interval than the time between droplet 2 emission, the computer 700 may close the normally closed channel of the valve 970. The plotter 800 may then position the target 1 or position a new target 1 as desired.

When printing, the active ingredient of the reagent is tailored to achieve a desired concentration per unit area on the target 1. However, to a certain extent the final concentration per unit area can be adjusted by varying the density of the droplets 2 printed on the target 1. The preferred embodiment is particularly well suited to this application due to its ability to print precise, discrete pels of reagent.

A second preferred embodiment of the jetting head is illustrated in Figs. 6a-6b and is generally represented as 400'. The jetting head 400' comprises housing formed into three sections 401', 402', 403'. The housing section 403' comprises a recessed region which forms the reagent fluid reservoir 200' when the housing section 403' is positioned against housing section 402'.

The jetting head 400' further comprises a piezo-electric transducer 434' and a reagent jetting tube 432' similar to those of the first embodiment. The jetting head 400' and the transducer 434' are most clearly shown in Fig. 6b. The jetting tube 432' defines an orifice 433' at one end and a reagent fluid receiving aperture 431' at the other end. The transducer 434' is mounted to the jetting tube 432' concentrically about the mid-region of the tube 432' with epoxy.

The transducer 434' and the jetting tube 432' are positioned in channels 420', 418', 416' located in the housing sections 402', 401'. The channel 416' comprises a plurality of sealing teeth 412' operative to engage and seal against the fluid receiving end 431' of the jetting tube 432'. The channel 416' is connected to the reagent fluid supply channel 430'. The supply channel 430' is connected with the fluid reservoir 200' by means of an aperture 431' through the housing section 402', shown in Fig. 6b.

The reservoir 200' comprises a flexible reservoir lining 201' adapted to contain the reagent fluid. The lining 201' comprises one aperture which is connected to the housing 402' to allow the fluid to pass from the lining 201'. A vent (not shown), located in the housing 403', allows the space between the reservoir 200' and the lining 201' to be vented or pressurized. A filter 300' is positioned within the aperture 202' to trap unwanted particulate foreign matter.

Electrical pulses are supplied to the transducer 434' by means of two contact pins 422'. The pins 422' are inserted through respective apertures 419' of the housing section 402' and respective apertures 421' of the housing section 403'. Two thin electrically conductive strips 410', 411', shown in Fig. 6b, are used to connect the transducer 434' with the contact pins 422'. A protective shield 405' extends from the housing position 403' to partially isolate the protruding portions of the contact pins 422'.

The function and operation of the jetting head 400' is similar to that of the jetting head 400 and therefore will not be discussed in detail. The collapsible inner lining 201' of the reservoir 200 allows the jetting tube 432' to be primed by pressurizing the reservoir 200' through the vent 205'. Once primed, the jetting head 400' may be used as described above in reference to the jetting head 400.

The jetting head 400' provides an advantage in that the entire fluidic system is contained in one housing. Such containment allows for fast and efficient replacement of the jetting heads without fluid contamination problems.

A third preferred embodiment of the jetting head is shown in Fig. 7 and generally represented as 400". The jetting head 400" comprises a housing 403", a reagent fluid supply tube 406", a piezo-electric transducer 434" and an orifice plate 404". The housing 403" defines a conically shaped fluid chamber 432". An orifice plate 404", defining an orifice 433", is fastened to the housing 403" such that the orifice 433" is located at or near the apex of the conical fluid chamber 432".

The fluid feed tube 406" is attached to the housing 403" and defines a supply channel 430". The supply channel 430" is in fluid communication with the fluid chamber 432" by means of a connecting channel 431". The base of the fluid chamber 432" is formed by the disc-shaped transducer 434". The transducer 434" is

held in position by a hold down plate 402" attached to the housing 403". The electrical connections to the transducer 434" are of conventional design and are therefore not shown. The housing 403" further comprises a threaded aperture 406" for mounting the jetting head 400".

The jetting head 400" operates in a manner similar to the jetting heads described above. However, in this jetting head the transducer 434" is normally disk shaped. When the electrical pulse is applied, the transducer 434" bends slightly, thereby altering the volume of the conically shaped jetting chamber 432". The change in volume of the chamber 432" causes the expulsion of fluid through the orifice 433" and the intake of fluid through the supply channel 430" as described in reference to the jetting head 400.

A fourth preferred embodiment of the jetting head is shown in Fig. 8 and is generally represented as 400". The jetting head 400" is very similar in form and function to the jetting head 400 and will not be described in detail. The jetting head 400" comprises two symmetrical housing sections. The sections may be connected together by means of apertures 409" and screws, not shown. When assembled, the housing sections 404", 402" form a T-shaped supply channel 410".

In operation, the jetting head 400" functions in a manner similar to the jetting head 400. The jetting head 400" is especially suited for use in the continuous mode, but may also be used in the drop on demand mode. In the continuous mode, the fluid is circulated continuously through the supply channel 430" allowing the jetting tube 432" to withdraw as much fluid as required.

By way of illustrating and with no limitations intended the following information is given to further illustrate the above described embodiments. The computer 700 is an IBM Corporation Personal Computer with 640 kbytes of RAM memory. The interface unit 600 is a Burr Brown interface unit model number PC 20001. The plotter 800 is manufactured by Houston Instrument as model number DMP-40. Communication between the plotter 800 and the interface unit 600 is performed through a standard asynchronous serial communication port.

The electrical pulse applied to the jetting head 400 to activate the transducer 434 comprises a rise time of approximately 5 usecs, a fall time of approximately 5 usecs and a pulse width of approximately 35 usecs. When the transducer 434 is operated in the drop on demand mode, the voltage potential of the pulse is 60 volts plus or minus 10 volts and the pulse frequency can be up to 4 khz. When the transducer 434 is operated in the continuous mode, the voltage potential of the pulse is 30 volts plus or minus 10 volts and the pulse frequency can be up to 10 khz.

The jetting tube 432 is manufactured from a pyrex glass tube and measures .027 inches outside diameter and .020 inches inside diameter. The tube is drawn to a closed taper in an electric furnace. The tapered end is then cut and ground to a desired orifice opening of .002 to .004 inches in diameter. The tube is cut to a final length of .945 inches in the case of the dispenser embodiment and ultrasonically cleaned in acetone. After being cleaned and dried the large end of the tube is fire polished. If desired, the orifice end of the tube may receive a coating, such as a hydrophobic polymer, to enhance droplet separation from the tube.

The supply tube 430 is formed from .023 inch inside diameter and .38 inch outside diameter polyethylene tubing produced by Intramedic Corp. as model number #14 170 11E. During assembly, one end of the tubing is stretched over a warm tapered mandrel. The stretched end of the supply tube 430 is then inserted over the large fire polished end of the jetting tube 432. The assembly is then cleaned and baked in a circulating air oven at 50°C. for 10 minutes.

The transducer 434 was purchased from Vernitron of Cleveland, Ohio as model number PZT-5H. The electrodes 437, 436 are comprised of nickel and are separated from each other on the outer surface of the transducer by approximately .030 inches. The jetting tube 432 is inserted into the cylindrical piezo-electric tube 434 and secured with epoxy manufactured by Epoxy Technology of Bellerica, Massachusetts as model number 301. The epoxy is applied at the junction of the tube 432 and transducer 434 with a syringe. The epoxy flows along the tube 432 inside the transducer 434 by capillary action. The assembly is then baked in a circulating air oven at 65°C. for one hour to cure the epoxy.

The contact pins 422 are secured to one of the housing sections 402, 404 with a drop of epoxy. The transducer jetting tube 434, 432 is placed in the housing such that the orifice end 433 of the tube 432 protrudes approximately .030 inches from the housing 403, 404. A drop of silver epoxy is placed between each contact pin 422 and the transducer 434 to ensure a secure electrical connection. Epoxy is also applied to the junction of the housing 402, 404 and supply tube 430. The other section of the housing 402, 404 is then screwed into place.

The periphery of the housing 402, 404 is sealed with a capillary sealer such as cyclohexanone. Epoxy is then added around each contact pin 422 and around the orifice end 433. The assembly is then baked in a circulating air oven at 65°C. for one hour.

The filter 300 is formed from a polyester mesh with 30 um pores and positioned in a polypropylene

housing. The air pressure supplied to the reservoir 200 during continuous printing operations is regulated at approximately 10 to 30 psi.

The reagents used have the following characteristics:

Printing (drop on demand mode):

5 Fluid viscosity range: 1 - 30 centipoises

Fluid surface tension: 20 - 70 dyne/cm

Printing (continuous mode):

Fluid viscosity range: up to 50 centipoises

Fluid surface tension: not measured

10 Dispensing (drop on demand mode):

Fluid viscosity range: 2 - 30 centipoises

Fluid surface tension: 20 - 70 dyne/cm

A measure of the performance and selected operating characteristics for a typical jetting head are presented in Figs. 9-11. Fig. 9 is a graph of the mass of a droplet as a function of droplet emission frequency for three fluids. The viscosity of the fluids were 1, 5 and 24 centipoise and the transducer excitation pulse width was 35 microseconds. As shown in Fig. 9, the higher fluid viscosity results in a more stable operating performance of the jetting head. Fig. 10 is a graph of droplet velocity as a function of droplet emission frequency for fluid viscosities of 1, 5 and 24 centipoise. The log of the total fluid weight as a function of the log of the number of droplets emitted is shown in Fig. 11. The fluid used has a viscosity of 2 centipoise, a surface tension of 20 dynes/cm, and a density of .8 grams/cc. The transducer excitation pulse was 80 volts and the excitation frequency was approximately 711 Hz.

Some blood typing reagents and some allergen reagents have very low viscosities and surface tensions. Although in some cases viscosity modifiers, such as glycerol, dextran, glucose, and the like, may be added to increase the viscosity, a few reagents are adversely affected by such modifiers.

25 Developing stable and reproduceable demand mode jetting is difficult with very low viscosities. Although droplet emission can be established at some fundamental frequencies, the droplets dispensed may have small satellite droplets which reduce the accuracy for metering and dispensing applications. However, even with the satellite drops, sufficient reagent is adequately delivered for most print applications without a substantial decrease in print quality.

30 Glycerin may be used as a viscosity modifier to improve jetting reliability and to prevent obstruction of the orifice arising from evaporation of the reagent fluid components. Glycerin has been found especially beneficial for those reagents containing particulate material. The evaporation of the fluid component results in a concentration of glycerin located at the orifice. The plug of glycerin substantially prevents further evaporation of the reagent fluid. During the next activation cycle of the transducer, the plug of glycerin is expelled from the orifice.

35 When operating in the dispensing mode the volume of the droplets can be varied to substantially uniformly contain from 100 pico-liters to 1 micro-liter. The droplets can be produced at a rate of approximately 1 khz to 8 khz. When operating in the printing mode the size of the pel made by each droplet measures approximately .001-.012 inches in diameter.

40 A copy of the program used in the computer 700 for a printing operation is attached hereto as Appendix A. The values, manufacturer and manufacturing part number of the circuit components of the jetting control unit 500 are substantially as follows:

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	Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
10	R39, 43-48, 57, 58	RES. 10KOHM $\frac{1}{2}$ WATT5% C.F.	
	R56	RES. 150OHM $\frac{1}{2}$ WATT5% C.F.	
	R3	RES. 15KOHM $\frac{1}{2}$ WATT5% C.F.	
15	R34	RES. 15KOHM $\frac{1}{2}$ WATT5% C.F.	
	R50	RES. 2.4KOHM $\frac{1}{2}$ WATT1% M.F.	DALE RLO792420
	R13, 23, 36, 40, 41	RES. 2.4KOHM $\frac{1}{2}$ WATT5% C.F.	
20	R56	RES. 20KOHM $\frac{1}{2}$ WATT5% C.F.	
	R8	RES. 220OHM $\frac{1}{2}$ WATT5% C.F.	
	R6	RES. 270OHM $\frac{1}{2}$ WATT5% C.F.	
	R7, 12, 25	RES. 2KOHM $\frac{1}{2}$ WATT5% C.F.	
	R57	RES. 3.6KOHM $\frac{1}{2}$ WATT5% C.F.	
25	R51, 53	RES. 3.9KOHM $\frac{1}{2}$ WATT5% C.F.	
	R29	RES. 300KOHM $\frac{1}{2}$ WATT5% C.F.	
	R61	RES. 30KOHM $\frac{1}{2}$ WATT1% M.F.	DALE RLO793030
	R15-18, 26-28, 54, 55, 64	RES. 4.7KOHM $\frac{1}{2}$ WATT5% C.F.	
30	R62	RES. 45.3KOHM $\frac{1}{2}$ WATT1% M.F.	DALE RM55D4532F
	R30, 33	RES. 470OHM $\frac{1}{2}$ WATT5% C.F.	
	R21	RES. 470OHM $\frac{1}{2}$ WATT5% C.F.	
	R19	RES. 47KOHM $\frac{1}{2}$ WATT5% C.F.	
	R35	RES. 510OHM $\frac{1}{2}$ WATT5% C.F.	
35	R43	RES. 6.2KOHM $\frac{1}{2}$ WATT5% C.F.	
	R50	RES. 7.5KOHM $\frac{1}{2}$ WATT5% C.F.	
	R37	RES. 75KOHM $\frac{1}{2}$ WATT5% C.F.	
	R9	RES. 75KOHM $\frac{1}{2}$ WATT1% M.F.	DALE RM60D7582F
	R11	RES. 820OHM $\frac{1}{2}$ WATT5% C.F.	
40	U2, 11, 14, 16, 22	RES. DIP NETWORK. 47KOHM	CT9 761-1R47K
	C21, 41, 45	CAP. AXIAL 1MF@250VDC	MALLORY #TC56
	C24	CAP. AXIAL 220MF@250VDC	MALLORY
	C10	CAP. AXIAL ALUM ELEC.	LP2219250C7P3
45		4700 CMF@25VDC	MALLORY
	C1, 2, 3, 55, 60	CAP. RADIAL DIPPED TANT.	TCG472U025N1C
		10MF@25VDC	KEMET
	C53	CAP. RADIAL DIPPED TANT.	T350E106M025AS
		1MF@35VDC	KEMET
50	C36	CAP. RADIAL DIPPED TANT.	T350A105K035AS
		47MF@10VDC	KEMET
			T350H366M010AS

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Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
C54	CAP. RADIAL SILV MICA 100PF300VDC	KAHGAN SD5101J301
C57	CAP. RADIAL SILV MICA 20PF300VDC	KAHGAN SP12200J301
C49	CAP. RADIAL SILV. MICA 39PF300VDC	KAHGAN SP12390J301
C39	CAP. RADIAL X7R MLC .015MF@50VDC	KEMET C315C102K1R5CA
C5	CAP. RADIAL X7R MLC .022MF@50VDC	KEMET C315C223K5R5CA
C30, 35, 37	CAP. RADIAL Z5U MLC .015MF@50VDC	KEMET C315C153K5R5CA
C4, 7	CAP. RADIAL Z5U MLC .01MF@50VDC	KEMET C315C103K5R5CA
C4, 5, 6, 9, 11-19, 22, 23, 25-28	CAP. RADIAL Z5U MLC .22MF@50VDC	KEMET C322C224X5U5CA
C31-34, 37, 42, 43 47, 48, 50-52		
C56, 58, 59		
C46	CAP. VARI. 1-12PF.	JOHANSEN #9626
CR7, 8, 9, 10, 11, 12, 17	DIODE SIL.	ITT. FAIRCHILD. 1N4148
CR1, 2, 3, 4	DIODE SIL. FAST	GENL. INST. EG100
CR5	DIODE SIL. FASTHIVOLT	GENL. INST. UF4007
CR6, 13, 15	DIODE SIL. REF. 2, 500VDC	NATL. SEMI-LM3852-2.5
CR14, 16	DIODE SIL. ZENER 3.8V. 25WATT	MOTOROLA 1N4622A
U6, 13, 15, 17	SWITCH 8 POSITION DIP	CTS 206-8
Q2, 9, 12	TRANSTOR. COMMON NPN	MOTOROLA 2N2222A
Q8, 10, 11	TRANSTOR. COMMON PNP	MOTOROLA 2N2907A
Q4	TRANSTOR. HIVOLTHIFREQ. NPN	MOTOROLA MPSU10
Q7	TRANSTOR. HIVOLTHIFREQ. PNP	MOTOROLA MPSU60
Q1	TRANSTOR. HIVOLTHIINPN	TI, MOTOROLA TIP46
Q3, 14	TRANSTOR. HIVOLTHIINPN 3439	MOTOROLA 2N3439
Q13	TRANSTOR. HIVOLTHIPNP	MOTOROLA MJE5731
U5, 27	IC 1-SHOT 74HC221	NATL. SEMI MM74HC221N
U23, 26	IC 1-SHOT 74LS221	NATL. SEMI DM74LS221N
U7-10	IC COMPARATOR 74HC688	NATL. SEMI MM74HC688N
U30	IC CONVERTER DAC0800	NATL. SEMI DAC0800LCN
U24, 25	IC COUNTER 74HC193	NATL. SEMI MM74HC193N
U28	IC HI SLEW HI VOLT OP AMP	BURR-BROWN 3584JX
U1	IC HYBRID DC/DC CONVERTER	BURR-BROWN MODEL 714
U4	IC OC DRIVER SN7406	NATL. SEMI DM7406N
U3	IC OCTAL LATCH 74HC374	NATL. SEMI MM74HC374N
U12, 29, 31, 32	IC OP AMP LF256	NATL. SEMI LF256H
U18, 19, 20, 21	IC OPTO ISOLATOR	HEWLETT-PACKARD HOP12300
R24, 42, 63	POT100KOHM%WATT10%	BOURNS 3622-1-104
R38, 49, 52	POT10KOHM%WATT10%	BOURNS 3622W-1-103
R20	POT25KOHM%WATT10%	BOURNS 3622W-1-253
R14, 31	POT2KOHM%WATT10%	BOURNS 3622W-1-202



Ref. Numeral of Component	Description and Value	Manufacturer and Part No.
5 VRI	REGULATOR 5VDC	
R10	RES. 1MEGOM $\frac{1}{2}$ WATTS%0.F.	NATL. LM340T-5.0
R2, 4	RES. 1.2KOHM $\frac{1}{2}$ WATTS%0.F.	
R32	RES. 1.6KOHM $\frac{1}{2}$ WATTS%0.F.	
R44	RES. 1.8KOHM $\frac{1}{2}$ WATTS%0.F.	
10 R1	RES. 10MEGOM $\frac{1}{2}$ WATTS%0.F.	
RS, R22	RES. 100HM $\frac{1}{2}$ WATTS%0.F.	
R65	RES. 100KOHM $\frac{1}{2}$ WATTS%0.F.	
R59	RES. 10KOHM $\frac{1}{2}$ WATTS%0.F.	
R100	RES. 270OHM	DALE RN55D10C2F
15 R101, 108	RES. 470OHM	
R102, 103	RES. 1KOHM	
106, 109, 110		
R104	RES. 4700OHM	
R105	POT. 100KOHM	
R107	POT. 10KOHM	
20 R111, 113	RES. 220OHM	
R112	RES. 220HM	
R114, 115	RES. 470HM	
C100	CAP. 10MFC35 VPC	
25 C108	CAP. 10000 PF	
D100	DIODE	1N4148
Q100, 105	TRANSTOR	2N2222
Q101, 102	TRANSTOR	2N3906
Q103, 104	TRANSTOR	2N3904
30 U100, U108	IC 1-SHOT	74LS123
U103, 104	IC INVERTOR	74LS04
105, 106		
U108	IC LINE DECODER	74LS138

Of course, it should be understood that a wide range of changes and modifications can be made to the preferred embodiments described above. For example, the transducer could be of a type other than piezo-electric such as magneto-strictive, electro-strictive, and electro-mechanical. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.

#### APPENDIX

5 Reagent Jet Printer  
Reagent Calibration

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IBM Personal Computer BASIC Compiler V2.00

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Offset Data Source Line
10 0030 0006 AER TITLE: 'Reagent Jet Printer' SSUBTITLE: 'Reagent Calibration' $LINESIZE: 132
    0030 0006 MODULE - 'RECAL'
    0030 0006
    0030 0006 AUTHOR - M. A. Enevold
    0030 0006
    0030 0006 COPYRIGHT (C) 1985 ABBOTT LABORATORIES
15 0030 0006 REVISION - 2.0 07-01-86 NAE MicroFab modifications
    0030 0006 - 1.0 02-11-86 NAE Creation of initial code
    0030 0006
    0030 0006 SYSTEM - This code can only be compiled by the BASCOM
    0030 0006 COMPILER, it will not run under the INTERPRETER!!
    0030 0006
20 0030 0006 DESCRIPTION:
    0030 0006 The reagent calibrate module presents a menu with 12 items arranged
    0030 0006 in 3 columns of 4 rows. The arrow keys allow movement around the
    0030 0006 table, the + and - keys increment or decrement values in the first
    0030 0006 column, and the enter key executes commands in the third column.
    0030 0006 The second column is an array of ASCII strings representing reagent name,
25 0030 0006 concentration, density, and viscosity. The values entered in column one
    0030 0006 are drop frequency, pulse width, strobe delay, and nozzle number.
    0030 0006 The commands in the third column are start/stop, load, save, and exit.
    0030 0006
    0030 0006 DATA DICTIONARY
    0030 0006
    0030 0006 MENUZ Pointer to which menu item is active (0-11)
30 0030 0006 MENU$(17,1) Array for strings used to display the menu
    0030 0006 MENU(17,4) Array for numbers in the menu display
    0030 0006 DIFFZ Differential to move MENUZ at arrow key input
    0030 0006 TYPEZ Pointer set during main scan to direct action
    0030 0006 KEYBUF$ Storage for string input from menu display
    0030 0006 AS Destination for single keystroke inputs
35 0030 0006 FILES String where filename is built for reagent data file
    0030 0006 REANAMES String where reagent name is stored
    0030 0006 RZ Row to display special graphics character in menu
    0030 0006 CZ Column to display special graphics character in menu
    0030 0006 SZ Special graphics character is read into here
    0030 0006 OLD.AMP.VALUEZ Integer value for setting pulse amplitude
40 0030 0006 DIG.VALZ Value set to digital port 0 to inc/dec amplitude
    0030 0006
    0030 0006 SUB REAGENT.CALIBRATE STATIC
    0047 0006
    0047 0006 DIM MENU$(17,1),MENU(17,4)
    0048 01FE
45 0048 01FE GOSUB INITIALIZE: 'read init. values and set screen
    004E 01FE
    004E 01FE WHILE TYPEZ < 1
    0059 0200
    0059 0200 TYPEZ = 0
    0060 0200 AS = ""
50 006A 0204
    006A 0204 WHILE AS = ""
    0079 0204 AS = INKEY$
    0083 0204 IF ACTIVEZ = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
    0080 0204
    0080 0204
55

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Reagent Jet Printer  
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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
25 0080	020A	IF AS = CHR\$(13) THEN TYPEZ = 1: 'execute (cr)
00CA	020A	IF AS = "+" THEN TYPEZ = 2: 'increment variable
00E0	020A	IF AS = "-" THEN TYPEZ = 3: 'decrement variable
00F6	020A	IF AS = CHR\$(0) + CHR\$(72) THEN TYPEZ = 4: 'up arrow key
0118	020A	IF AS = CHR\$(0) + CHR\$(80) THEN TYPEZ = 5: 'down arrow key
0140	020A	IF AS = CHR\$(0) + CHR\$(75) THEN TYPEZ = 6: 'left arrow key
30 0165	020A	IF AS = CHR\$(0) + CHR\$(77) THEN TYPEZ = 7: 'right arrow key
018A	020A	IF AS > CHR\$(47) AND AS < CHR\$(123) THEN TYPEZ = 8: 'ascii 0 - z
01C2	020A	
01C2	020A	ON TYPEZ GOSUB T1, T2, T3, T4, T5, T6, T7, T8
01DB	020A	
01DB	020A	WEND
35 01DF	020A	TYPEZ = 0
01E6	020A	
01E6	020A	EXIT SUB
01EA	020A	REN SPAGE

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5 Reagent Jet Printer  
Reagent Calibration

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IEN Personal Computer BASIC Compiler V2.00

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Offset  Data  Source Line
-----
10 01EA 020A ***** SUBROUTINES FOR THIS MODULE *****
01EA 020A
01EA 020A T1:      '(<cr>) execute command
01EF 020A      IF MENUZ < 12 THEN TYPEZ = 0:RETURN:      'exit to print menu, no action
0205 020C      ON MENUZ - 11 GOSUB T1A, T1B, T1C, T1D
021A 020C      IF MENUZ < 15 THEN TYPEZ = 0
022C 020C      RETURN
15 0230 020C      'start/stop drop flow
0230 020C T1A:
0233 020C      IF MENUZ(12,0) = "START" THEN GOSUB START.INX
025A 020C      IF MENUZ(12,0) = "STOP" THEN GOSUB STOP.INX
027F 020C      MENUZ(12,0) = TEMP$
029A 0210      COLOR 0,7:GOSUB DISPMENU
20 02AC 0210      RETURN
02B0 0210
02B0 0210 START.INX:
02B5 0210      TEMP$ = "STOP"
02BF 0210      CALL DOT.ON:      'in module PCI
25 02CB 0210      LOCATE 17,71:COLOR 27,0:PRINT "PRINTING";
02F1 0210      ACTIVEZ = 1
02FB 0210      RETURN
02FC 0210
02FC 0210 STOP.INX:
30 0301 0210      TEMP$ = "START"
030B 0210      CALL DOT.OFF:      'in module PCI
0317 0210      LOCATE 17,71:COLOR 15,0:PRINT " ";
033D 0210      ACTIVEZ = 0
0344 0210      RETURN
0348 0210
0348 0210 T1B:      'load reagent profile
35 034D 0210      IF MENUZ(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
0391 0210
0391 0210      GOSUB SEARCH
0397 0210
0397 0210      IF IZ < (REAGENT$ + 1) THEN GOTO FOUND
03A8 0214      LOCATE 25,10-LEN(MENUZ(6,1))/2:PRINT MENUZ(6,1);" not Found";
40 0404 0214      GOSUB ANYKEY:      'wait for a keyhit
040A 0214      RETURN
040E 0214
040E 0214 FOUND:
45 0413 0214      FILES = RIGHTS(STR$(IZ),LEN(STR$(IZ))-1) + "REA.R3P"
0437 0218      OPEN FILES FOR INPUT AS #1:      'set pattern data file for read
0448 0218      INPUT #1,MENU(0,0):      'read frequency
0468 0218      INPUT #1,MENU(1,0):      'read amplitude
0488 0218      INPUT #1,MENU(2,0):      'read strobe delay
04AE 0218      INPUT #1,MENU(3,0):      'read pulse width
04D1 0218      INPUT #1,MENU(4,0):      'read rise time
04F4 0218      INPUT #1,MENU(5,0):      'read fall time
50 0519 0218
0519 0218      INPUT #1,MENU(7,1):      'read concentration
053D 0218      INPUT #1,MENU(8,1):      'read density
0561 0218      INPUT #1,MENU(9,1):      'read viscosity
0585 0218      INPUT #1,MENU(10,1):      'read surface tension
55 05A9 0218

```

5 Reagent Jet Printer  
Reagent Calibration

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IBM Personal Computer BASIC Compiler V2.30

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Offset  Data      Source Line
-----  -
05A9  0218      CLOSE #1:      'done with data file
10 05B0  0218
05B0  0218      OPEN "REDEF.RJP" FOR OUTPUT AS #1
05C2  0218      PRINT #1,FILES:      'save filename in default file
05D2  0218      PRINT #1,MENU$(6,1): 'save the directory name as well
05F4  0218      CLOSE #1
05F8  0218      GOSUB DISP.PARMS:    'show all parameters
15 0601  0218      RETURN
0603  0218
0603  0218      TIC:      'save reagent profile
060A  0218      IF MENU$(6,1) = "" THEN LOCATE 25,1:PRINT "Reagent Name is not specified";:GOSUB ANYKEY:RETURN
064E  0218      OPEN "READIR.RJP" FOR INPUT AS #1
065F  0218      INPUT #1,REANUM%
20 0671  0218      CLOSE #1
0678  0218      IF REANUM% < 80 THEN GOTO SAVE.REA
0687  0218      LOCATE 25,1:PRINT "Directory is Full (80 reagents max.)"
06A1  0218      GOSUB ANYKEY:RETURN
06AB  0218      SAVE.REA:
06B0  0218      GOSUB SEARCH
25 06B6  0218      IF I% > REANUM% THEN GOTO SAVEREA1
06C7  0218      REANUM% = I%
06CE  0218      COLOR 15,0
06DA  0218      LOCATE 25,1:PRINT MENU$(6,1);" already exists. Replace it with new values? ";
070C  0218      AS = ""
0716  0218      WHILE AS = ""
30 0725  0218          AS = INKEY$
072F  0218      WEND
0732  0218      LOCATE 25,1:PRINT SPACES(79);
074F  0218      IF AS = "Y" OR AS = "y" THEN GOTO REPLACE
0778  0218      RETURN
077C  0218
35 077C  0218      SAVEREA1:
0781  0218      KILL "READIR.OLD":      'delete old backup directory
0788  0218      NAME "READIR.RJP" AS "READIR.OLD":      'save old directory
0792  0218      OPEN "READIR.OLD" FOR INPUT AS #1
07A3  0218      OPEN "READIR.RJP" FOR OUTPUT AS #2:      'set up new dir
40 07B5  0218
07B5  0218      INPUT #1,REANUM%:      'read number of dir entries
07C7  0218      REANUM% = REANUM% + 1:      'increase by 1
07D0  0218      WRITE #2,REANUM%:      'save in new directory
07E1  0218
07E1  0218      FOR I=1 TO REANUM% - 1
45 07FA  021C          LINE INPUT #1,AS:      'read entry from old dir
0807  021C          PRINT #2,AS:      'write entry in new directory
0817  021C      NEXT I
0832  0220
0832  0220      CLOSE #1
0839  0220
50 0839  0220      PRINT #2,MENU$(6,1):      'write new entry to new directory
085B  0220      CLOSE #2:      'done with directory
0862  0220
0862  0220      REPLACE:
0867  0220      FILES = RIGHTS$(STR$(REANUM%)) + " " + "READIR.RJP"
0888  0220

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Reagent Jet Printer  
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IBM Personal Computer BASIC Console V2.00

Offset	Addr	Source Line
10	088B 0220	OPEN FILE# FOR OUTPUT AS #1: 'create new pattern data file
	089D 0220	WRITE #1,MENU(0,0): 'store frequency
	08B0 0220	WRITE #1,MENU(1,0): 'store amplitude
	08DC 0220	WRITE #1,MENU(2,0): 'store strobe delay
	08FD 0220	WRITE #1,MENU(3,0): 'store pulse width
	091E 0220	WRITE #1,MENU(4,0): 'store rise time
15	093F 0220	WRITE #1,MENU(5,0): 'store fall time
	0962 0220	
	0962 0220	WRITE #1,MENU(7,1): 'store concentration
	0984 0220	WRITE #1,MENU(8,1): 'store density
	09A6 0220	WRITE #1,MENU(9,1): 'store viscosity
	09CB 0220	WRITE #1,MENU(10,1): 'store surface tension
20	09EA 0220	
	09EA 0220	CLOSE #1: 'done with data file
	09F1 0220	
	09F1 0220	OPEN "READER.RIP" FOR OUTPUT AS #1
	0A03 0220	PRINT #1,FILES: 'save filename in default file
	0A13 0220	PRINT #1,MENU(16,1): 'save the directory name as well
25	0A35 0220	CLOSE #1
	0A3C 0220	RETURN
	0A40 0220	
	0A40 0220	SEARCH:
	0A45 0220	OPEN "READIR.RIP" FOR INPUT AS #1
	0A56 0220	INPUT #1,REARNT: 'read number of patterns in dir
30	0A68 0220	IX = 1: 'set entry pointer
	0A6F 0220	
	0A6F 0220	SLOOP:
	0A74 0220	LINE INPUT #1,AS: 'read next pattern name from dir
	0A81 0220	IF AS = MENU(16,1) THEN GOTO SEARCH.DONE: 'compare name with dir entry
	0A85 0220	IX = IX + 1
35	0AAE 0220	IF IX < (REARNT + 1) THEN GOTO SLOOP: 'check for done
	0AC1 0220	SEARCH.DONE:
	0AC6 0220	CLOSE #1
	0ACD 0220	RETURN
	0AD1 0220	
40	0AD1 0220	TID: 'return with no change to exit reagent calibrate
	0AD6 0220	PRINT #3,"UN";
	0AE6 0220	CLOSE #3: 'close con channel
	0AE8 0220	RETURN
	0AF1 0220	
	0AF1 0220	T2: 'process "*" key
45	0AF6 0220	IF MENU(1) > 5 THEN RETURN
	0B05 0220	MENTIME = TIMER
	0B0F 0220	DELTAIME = MENTIME - OLDTIME
	0B1F 0220	OLDTIME = MENTIME
	0B29 0220	IF DELTAIME > 0.15 THEN MULTZ = 1 ELSE MULTZ = MULTZ + 1
	0B40 0220	IF MULTZ > 100 THEN MULTZ = 100
50	0B58 0220	MENU(MENU(0,0) + MENU(MENU(0,0) + MENU(MENU(0,0) + MULTZ): 'add increment
	0B9F 0220	IF MENU(MENU(0,0) > MENU(MENU(0,0)) THEN MENU(MENU(0,0) = MENU(MENU(0,0)): 'check max value
	0C06 0220	COLOR 15,1:GOSUB DISPMENU:RETURN: 'show new value
	0C10 0220	
	0C10 0220	T3: 'process "-" key
	0C22 0220	IF MENU(1) > 5 THEN RETURN
55	0C31 0220	MENTIME = TIMER

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Offset	Data	Source Line
10 0C3B	022E	DELTA TIME = NEWTIME - OLDTIME
0C4B	022E	OLDTIME = NEWTIME
0C55	022E	IF DELTA TIME > 0.15 THEN MULTZ = 1 ELSE MULTZ = MULTZ + 1
0C77	022E	IF MULTZ > 100 THEN MULTZ = 100
0C89	022E	MENU(MENUZ,0) = MENU(MENUZ,0) - MENU(MENUZ,3) * MULTZ: 'sub increment
0CC3	022E	IF MENU(MENUZ,0) < MENU(MENUZ,2) THEN MENU(MENUZ,0) = MENU(MENUZ,2): 'check min value
15 00C2	022E	COLOR 15,1:GOSUB DISPMENU:RETURN: 'show new value
0049	022E	
0049	022E	T4: 'process up arrow key
004E	022E	IF MENUZ MOD 6 = 0 THEN RETURN: 'in top row already
0063	022E	DIFFZ = -1:GOSUB NEWMENU:RETURN: 'move pointer up one
0074	0230	
20 0074	0230	T5: 'process down arrow key
0079	0230	IF MENUZ MOD 6 = 5 THEN RETURN: 'in bottom row already
008F	0230	DIFFZ = 1:GOSUB NEWMENU:RETURN: 'move pointer down one
0DA0	0230	
0DA0	0230	T6: 'process left arrow key
0DAS	0230	IF INT(MENUZ / 6) = 0 THEN RETURN: 'in left column already
25 00E3	0230	DIFFZ = -6:GOSUB NEWMENU:RETURN: 'move pointer one left
00D6	0230	
00D6	0230	T7: 'process right arrow key
00DB	0230	IF INT(MENUZ / 6) = 2 THEN RETURN: 'in right column already
00FE	0230	DIFFZ = 6:GOSUB NEWMENU:RETURN: 'move pointer one right
0E0F	0230	
30 0E0F	0230	T8: 'input keys into KEYBUFs until (cr) is entered
0E14	0230	IF MENUZ > 10 THEN RETURN
0E23	0230	LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0E33	0230	KEYBUFs = AS
0E3F	0234	WHILE AS <> CHR\$(13)
0E72	0234	LOCATE 25,47:PRINT SPACES(15);
35 0E8F	0234	LOCATE 25,47:PRINT KEYBUFs;
0EA9	0234	AS = ""
0EB3	0234	WHILE AS = ""
0EC2	0234	AS = INKEY\$
0ECC	0234	IF ACTIVE\$ = 1 AND DOWNTIME < TIMER THEN GOSUB PEN.DOWN
40 0EF6	0234	END
0EF9	0234	IF AS = CHR\$(8) AND LEN(KEYBUFs) > 0 THEN KEYBUFs = LEFT\$(KEYBUFs,LEN(KEYBUFs)-1)
0F3B	0234	IF AS = CHR\$(13) AND LEN(KEYBUFs) < 15 THEN KEYBUFs = KEYBUFs + AS
0F75	0234	END
0F79	0234	
0F79	0234	IF MENUZ > 5 THEN GOTO STORESTRING
0F88	0234	
45 0F88	0234	TEMP = VAL(KEYBUFs) 'temp has value of keys input
0F9B	0238	
0F9B	0238	'round off temp according to step size in menu array
0F9B	0238	TEMP = INT(TEMP / (MENU(MENUZ,3) * .5) + MENU(MENUZ,3)
0FD1	0238	
50 0FD1	0238	'test TEMP for maximum and minimum values in menu array
1019	0238	IF TEMP > MENU(MENUZ,1) THEN TEMP = MENU(MENUZ,1)
104F	0238	IF TEMP < MENU(MENUZ,2) THEN TEMP = MENU(MENUZ,2)
104F	0238	
104F	0238	'insert new value into menu array and update screen
104F	0238	MENU(MENUZ,0) = TEMP
55 106B	0238	LOCATE 25,30:PRINT SPACES(40);

5 Reagent Jet Printer  
Reagent Calibration

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ISA Personal Computer BASIC Compiler V2.00

Offset	Date	Source Line
10	1088 0238	COLOR 0,7:GOSUB DISPMENU
	109A 0238	RETURN
	109E 0238	
	109E 0238	STORSTRINGS:
	10A3 0238	MENU\$(MENUZ,1) = KEYBUF\$
	10B8 0238	LOCATE 25,30:PRINT SPACES(40);
15	10DC 0238	COLOR 0,7:GOSUB DISPMENU
	10EE 0238	RETURN
	10F2 0238	
	10F2 0238	PEN.DOWN:
	10F7 0238	DOWNTIME = TIMER + 1
	1107 0238	PRINT 83,"D";
20	1117 0238	RETURN
	111B 0238	
	111B 0238	ANYKEY:
	1120 0238	LOCATE 25,64:PRINT "Strike any key..";
	113A 0238	AS = ""
	1144 0238	WHILE AS = ""
25	1153 0238	AS = INKEY\$
	115D 0238	WEND
	1160 0238	LOCATE 25,1:COLOR 15,0:PRINT SPACES(79);:COLOR 15,1
	1196 0238	RETURN
	119A 0238	
	119A 0238	NEWMENU: 'write old item in yellow. point to and highlight new item
30	119F 0238	COLOR 14,0:GOSUB DISPMENU
	11B1 0238	MENUZ = MENUZ + 01FFH
	11BD 0238	IF MENUZ = 11 THEN MENUZ = 10
	11CF 0238	IF MENUZ > 15 THEN MENUZ = 15
	11E1 0238	COLOR 0,7:GOSUB DISPMENU:RETURN
	11F7 0238	
35	11F7 0238	INITIALIZE:
	11FC 0238	'change to second screen and display messages
	11FC 0238	SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,28:PRINT "Initializing Menu Display";
	1240 0238	LOCATE 12,33:PRINT "Please wait..."
	125A 0238	
	125A 0238	'initialize variables
40	125A 0238	
	125A 0238	ACTIVEZ = 0: ' not printing
	1261 0238	
	1261 0238	'initialize plotter con channel
	1261 0238	
45	1261 0238	OPEN "COM1:2400,N,8,2" AS #3
	1273 0238	PRINT #3,"::UECS,EFV1,N";
	1283 0238	
	1283 0238	'initialize digital port
	1283 0238	SCRZ = 4
	128A 023A	CALL DIGITAL.OUT(SCRZ)
	129A 023A	SCRZ = 0
50	12A1 023A	CALL DIGITAL.OUT(SCRZ): 'pulse reset line to set amplitude to 0V.
	12B1 023A	SCRZ = 4
	12B8 023A	CALL DIGITAL.OUT(SCRZ)
	12CB 023A	
	12CB 023A	'set hardware pulse width
55	12CB 023A	CALL SET.OUT.WIDTH(5) 'in module PCI



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Reagent Jet Printer  
Reagent Calibration

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
10 12DE	023C	'initialize menu arrays
12DE	023C	RESTORE ARGDATA
12DE	023C	FOR IZ=0 TO 17
12E3	023C	READ MENU(IZ,0),MENU(IZ,1)
12E9	023C	READ MENU(IZ,1),MENU(IZ,2),MENU(IZ,3),MENU(IZ,4)
1318	023C	NEXT IZ
15 137C	023C	'set default reagent values
138F	023C	
138F	023C	
138F	023C	
138F	023C	MENU(0,0) = 2000:           'frequency
13A8	023C	MENU(1,0) = 0:           'applitude
20 13C4	023C	MENU(2,0) = 1:           'strobe delay
13E0	023C	MENU(3,0) = 090:       'pulse width
13FC	023C	MENU(4,0) = 470:       'rise time
1418	023C	MENU(5,0) = 070:       'fall time
1436	023C	
1436	023C	MENU(6,0) = 0:           'naae
25 1452	023C	MENU(7,0) = 0:           'concentration
146E	023C	MENU(8,0) = 0:           'density
148A	023C	MENU(9,0) = 0:           'viscosity
14A6	023C	MENU(10,0) = 0:       'surface tension
14C2	023C	
14C2	023C	OLD.ANP.VALUE1 = 0       'initial value of 0 volts
30 14C9	023E	
14C9	023E	'change active displayed screen to first screen to draw and display parameters
14C9	023E	
14C9	023E	SCREEN 0,0,0,1:CLS
14E6	023E	
14E6	023E	COLOR 13:LOCATE 1,32:PRINT "REAGENT CALIBRATE";
35 1507	023E	COLOR 9
150E	023E	FOR I=2 TO 79
1518	023E	LOCATE 3,1:PRINT "0";LOCATE 5,1:PRINT "8";LOCATE 19,1:PRINT "9";
156F	023E	NEXT I
158A	023E	FOR I=4 TO 18
1594	023E	LOCATE 1,1:PRINT "3";LOCATE 1,28:PRINT "0";LOCATE 1,69:PRINT "0";LOCATE 1,80:PRINT "3";
40 1608	023E	NEXT I
1626	023E	RESTORE TABLE
1628	023E	FOR I=1 TO 12
1637	023E	READ R1,C1,N1:LOCATE R1,C1:PRINT CHR\$(N1);
166A	0244	NEXT I
45 1685	0244	'print three headings and instructions
1685	0244	COLOR 10,0
1691	0244	LOCATE 4,7:PRINT "DROP PARAMETERS";
16A8	0244	LOCATE 4,39:PRINT "REAGENT PARAMETERS"
16C5	0244	LOCATE 4,71:PRINT "COMMANDS";
50 16DF	0244	
16DF	0244	COLOR 7:LOCATE 21,20:PRINT "Use ";:COLOR 15:PRINT CHR\$(27);CHR\$(32);CHR\$(26);
1729	0244	PRINT CHR\$(22);CHR\$(24);CHR\$(32);CHR\$(25);:COLOR 7:PRINT " to position highlighted cursor";
1768	0244	LOCATE 23,18:PRINT "Use ";:COLOR 15:PRINT "0";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "1";
178E	0244	COLOR 7:PRINT " to scroll current value up or down";
17D2	0244	LOCATE 23,26:PRINT "Use ";:COLOR 15:PRINT "07";:COLOR 7:PRINT " to activate selection";
55 1814	0244	

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Reagent Jet Printer  
Reagent Calibration

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IBM Personal Computer BASIC Compiler V2.00

	Offset	Data	Source Line
25	1814	0244	DISP.PARMS:
	1819	0244	'display 12 menu choices in yellow
	1819	0244	
	1819	0244	COLOR 14,0
	1825	0244	FOR MENUZ = 0 TO 17
30	1829	0244	GOSUB DISPMENU
	1831	0244	NEXT MENUZ
	1841	0244	
	1841	0244	'set for reagent name and highlight it
	1841	0244	MENUZ = 6:COLOR 0,7
	1854	0244	GOSUB DISPMENU
35	185A	0244	
	185A	0244	SCREEN 0,0,0,0
	186F	0244	RETURN
	1873	0244	REM SPAGE

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Reagent Jet Printer  
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IBM Personal Computer BASIC Compiler V2.00

```

10 Offset Data Source Line
1673 0244 DISPMENU:
1678 0244 LOCATE (MENUZ MOD 6)*2+7,(INT(MENUZ/6)*28+2)+15+INT(MENUZ/12)
1804 0244 PRINT MENU$(MENUZ,0)
18F2 0244 IF MENUZ > 5 THEN GOTO SHOWSTRING: 'no value to display
15 1901 0244 LOCATE (MENUZ MOD 6)*2+7,MENU(MENUZ,4)
1933 0244 PRINT USING MENU$(MENUZ,1);MENU(MENUZ,0);
1966 0244 IF MENUZ > 2 THEN RETURN
1975 0244 ON MENUZ+1 GOSUB SET.FREQ, SET.AMP, SET.DELAY
1986 0244 RETURN
20 198A 0244 SHOWSTRING:
198F 0244 IF MENUZ > 10 THEN RETURN
199E 0244 LOCATE (MENUZ MOD 6)*2+7,48
198A 0244 PRINT "
19C7 0244 LOCATE (MENUZ MOD 6)*2+7,48
19E3 0244 PRINT MENU$(MENUZ,1)
25 1A02 0244 RETURN
1A06 0244 SET.FREQ:
1A08 0244 TEMP = MENU(0,0)
1A24 0244 CALL SET.DOT.RATE(TEMP); 'in module PCI
1A34 0244 LEDZ = 3-INT((TEMP-500)/1000)
30 1A57 0244 IF LEDZ < 0 THEN LEDZ = 0
1A69 0244 SCRZ = 4 + (LEDZ * 32); 'set LED intensity
1A89 0244 CALL DIGITAL.OUT(SCRZ); 'in module PCI
1A99 0244 RETURN
1A9D 0244 SET.AMP:
35 1A22 0244 SCRZ = CINT(MENU(MENUZ,0) * 100 / 150); 'convert volts to binary number
1AC3 0244 IF SCRZ = OLD.AMP.VALUEZ THEN RETURN
1ACC 0244 TEMP1 = SCRZ - OLD.AMP.VALUEZ; 'calculate delta
1AE3 0244 OLD.AMP.VALUEZ = SCRZ; 'update old value to current value
1AEF 0244 DIG.VALZ = 6
1AF6 0244 IF TEMP1 < 0 THEN DIG.VALZ = 5
40 1B08 0244 TEMP1 = ABS(TEMP1)
1B15 0244 FOR IZ = 1 TO TEMP1
1B22 0244 SCRZ = DIG.VALZ + (32*LEDZ)
1B3F 0244 CALL DIGITAL.OUT(SCRZ); 'pulse higher or lower
1B4F 0244 SCRZ = 4 + (32 * LEDZ)
1B6F 0244 CALL DIGITAL.OUT(SCRZ); 'set port to normal
45 1B7F 0244 NEXT IZ
1B91 0244 RETURN
1B95 0244 SET.DELAY:
1B9A 0244 TEMP = MENU(2,0)
1B96 0244 CALL SET.STROBE.DELAY(TEMP); 'in module PCI
50 1BC6 0244 RETURN
1BCA 0244
18CA 0244 REM SPACE

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Reagent Jet Printer  
 10 Reagent Calibration

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
18CA	024C	***** DATA USED BY THIS MODULE *****
18CA	024C	
15 18CA	024C	ARRDATA:
18CF	024C	DATA "Frequency" Hz,"99,999",10000,1,1,16
18D1	024C	DATA "Amplitude" V,"999",150,0,1,19
18D3	024C	DATA "Strobe Delay" uS,"99,999.9",15999.5,.5,.5,16
18D5	024C	DATA "Pulse Width" ,"999",999,0,1,19
18D7	024C	DATA "Rise Time" ,"999",999,0,1,19
20 18D9	024C	DATA "Fall Time" ,"999",999,0,1,19
18DB	024C	DATA "Wave","",0,0,0,0
18DD	024C	DATA "Concentration","",0,0,0,0
18DF	024C	DATA "Density","",0,0,0,0
18E1	024C	DATA "Viscosity","",0,0,0,0
18E3	024C	DATA "Surface Tension","",0,0,0,0
25 18E5	024C	DATA "", "", 0,0,0,0
18E7	024C	DATA "START","",0,0,0,0
18E9	024C	DATA "LOAD","",0,0,0,0
18EB	024C	DATA "SAVE","",0,0,0,0
18ED	024C	DATA "EXIT","",0,0,0,0
18EF	024C	DATA "", "", 0,0,0,0
30 18F1	024C	DATA "", "", 0,0,0,0
18F3	024C	
18F3	024C	TABLE:
18F8	024C	DATA 3,1,218
18FA	024C	DATA 3,28,210
18FC	024C	DATA 3,69,210
35 18FE	024C	DATA 3,80,191
1C00	024C	DATA 5,1,198
1C02	024C	DATA 5,28,206
1C04	024C	DATA 5,69,206
1C06	024C	DATA 5,80,181
1C08	024C	DATA 19,1,192
40 1C0A	024C	DATA 19,28,208
1C0C	024C	DATA 19,69,208
1C0E	024C	DATA 19,80,217
1C10	024C	
1C10	024C	END SUB
1C17	024C	
45 1C17	024C	
23EB-	024C	

50426 Bytes Available  
 43960 Bytes Free

50 0 Warning Error(s)  
 0 Severe Error(s)

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Reagent Jet Printer  
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
0030	0006	REM TITLE: 'Reagent Jet Printer' \$SUBTITLE: 'Pattern Entry/Modification'
0030	0006	'MODULE - 'PATENT' Pattern creation, modification, and filing
0030	0006	.
0030	0006	'AUTHOR - M. A. Enevold
0030	0006	.
0030	0006	'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
0030	0006	.
0030	0006	'REVISION - 1.2 03-10-86 NAE Remove Mouse inputs
0030	0006	1.1 02-20-86 NAE Add 90 pattern limit to save
0030	0006	1.0 01-13-86 NAE Creation of initial code
0030	0006	.
0030	0006	'SYSTEM - This code can only be compiled by the BASCOM
0030	0006	COMPILER, it will not run under the INTERPRETER!!
0030	0006	.
0030	0006	'DESCRIPTION:
0030	0006	This module allows the user to LOAD, SAVE, DIRectory, D
0030	0006	RAW and
0030	0006	enter repeat count and other parameters for a pattern. t
0030	0006	o be printed.
0030	0006	The low-resolution graphics mode is selected and a menu
0030	0006	is displayed
0030	0006	across the bottom of the screen. Using arrow keys
0030	0006	point to the action to be taken and then invoke that ac
0030	0006	tion with the
0030	0006	Enter key. In the RAW mode, another menu is
0030	0006	displayed which allows the user to select from LINE, RE
0030	0006	CTangle,
0030	0006	Solid RECTangle, or CIRCLE pattern elements.
0030	0006	.
0030	0006	'DATA DICTIONARY
0030	0006	SCNDATZ(50,5) 51 Row (Elements) by 6 Coluan array f
0030	0006	or storing pattern elements
0030	0006	CURSORS(9) Storage for cursor graphics icon
0030	0006	MENUS(6) Up to 7 menu names can be saved here
0030	0006	ELNUMZ Count of number of elements in a patt
0030	0006	ern
0030	0006	IX YI
0030	0006	GRID
0030	0006	(default is 0.005")
0030	0006	ROWZ COLZ
0030	0006	AS
0030	0006	nt strings
0030	0006	MENUNUM
0030	0006	)
0030	0006	ITEM
0030	0006	hted (0 - 6)
0030	0006	REPEATZ
0030	0006	ated when printed
0030	0006	IDFF YOFF
0030	0006	nting of repeated patterns
0030	0006	ROWSP COLSP
0030	0006	ultiple sets of patterns

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Reagent Jet Printer  
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Offset	Data	Source Line	
0030	0006	PATNUMZ	Number of patterns stored in the pattern directory PATDIR.RJP
0030	0006	DROWZ DCOLZ	Row and Column location to display directory entries
0030	0006	NAMES	Pattern name to be LOADED or SAVED to directory
0030	0006	IZ JZ	Counters used to LOAD or SAVE the element data from/to pattern data file
0030	0006	FILES	Name of pattern data file
0030	0006	TEMPZ	Which type of element is being drawn. 1 = Line 2 = Rectangle
0030	0006		3 = Solid Rectangle 4 = Circle
0030	0006	FLAGZ	Same as TEMPZ above
0030	0006	STARTMSG\$ ENDMSG\$	Message display for startpoint and endpoint of element entry
0030	0006	IXZ YIZ	Starting cursor position for element being drawn
0030	0006	DXZ DYZ	Delta X and Y values used to re-position cursor after arrow key
0030	0006	MAXITEM	The highest number item in the current menu display
0030	0006	IS XE	Starting and ending X position of the menu highlighting blue box
0030	0006	RADIUSZ	The calculated radius of a circle to be displayed
0030	0006	REM SPAGE	

Reagent Jet Printer  
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

```

10      Offset Data Source Line
      0030 0006 SUB PATENTRY STATIC
      0047 0006
      0047 0006 WIDTH 40:SCREEN 1:CLS
15      005F 0006 DIM SCNDATZ(50,5),CURSORZ(9),MENU$(6)
      0060 029A ELNUMZ = 0:IX=0:YI=0:GRID = 0.005
      007F 02A4
      007F 02A4 LINE (0,0)-(6,6),,B
20      00A1 02A4 LINE (0,3)-(6,3),,B
      00C5 02A4 LINE (3,0)-(3,6),,B
      00E9 02A4 PRESET (3,3)
      00F5 02A4 GET (0,0)-(6,6),CURSORZ
      0116 02A4 CLS
25      011D 02A4
      011D 02A4 LINE (0,0)-(319,190),,B
      0140 02A4
      0140 02A4 RESTORE INSTRU
      0147 02A4 FOR I=1 TO 4
30      0151 02A4 READ ROWZ,COLZ,AS
      0164 02AC LOCATE ROWZ,COLZ:PRINT AS;
      0180 02AC NEXT I
      0198 0280
      0198 0280 FIRST:
35      01A0 0280 MENUNUM = 1
      01AA 0284 GOSUB SUBMENU
      0180 0284
      0180 0284 CN ITEM + 1 GOTO PATDIR, PATLOAD, PATSAVE, PATDRAW, REP
      EAT, PATEXT
40      01C0 0288 GOTO FIRST
      01D0 0288
      01D0 0288 REPEAT:
      01D5 0288 GOSUB ITEMBOXERASE: 'erase blue box around DIR
      01D8 0288 LOCATE 25,1:PRINT SPACES(39); 'erase menu line
      01F8 0288 LOCATE 25,1:INPUT;"Enter Repeat Count ",REPEATZ
45      0218 028A LOCATE 25,1:PRINT SPACES(39); 'erase menu line
      0235 028A LOCATE 25,1:INPUT;"Enter X Axis Offset ",XOFF
      0255 028E LOCATE 25,1:PRINT SPACES(39); 'erase menu line
      0272 028E LOCATE 25,1:INPUT;"Enter Y Axis Offset ",YOFF
50      0292 02C2 GOTO FIRST
      0296 02C2 PATEXT:
      0298 02C2 WIDTH 80:SCREEN 0:CLS
      02B2 02C2 EXIT SUB
      02B6 02C2 REM $PAGE

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Reagent Jet Printer  
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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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0286 02C2 PATDIR: 'list directory of patterns
0288 02C2 GOSUB ITEM$OIERASE: 'erase blue box around DIR
15 02C1 02C2 LOCATE 25,1:PRINT SPACES(39); 'erase menu line
02DE 02C2 OPEN "PATDIR.RJP" FOR INPUT AS #1: 'open directory
file
02EF 02C2 INPUT #1, PATNUMZ: 'read number of patterns in dir
ectory
20 0301 02C4 LINE (1,1)-(318,169),0,BF: 'erase graphics tablet
0326 02C4 I = 0: 'set counter
0330 02C4
0330 02C4 DISLOOP:
0335 02C4 I = I + 1: 'set for next value
25 0344 02C4 IF I > PATNUMZ THEN GOTO DIREXIT: 'test for done
0358 02C4 IF INT((I-1)/44) <> (I-1)/44 THEN GOTO SHOWNEXT
0364 02C4 IF INT((I-1)/44) < 1 THEN GOTO SHOWNEXT
03A9 02C4
03A9 02C4 LOCATE 25,1:PRINT "More to Display. Continue ? (Y or N)
30 ";
03C3 02C4 GOSUB CORLOOP: 'wait for Y or N response
03C9 02C4 IF AS = "N" THEN GOTO DIREXIT: 'if N then don't contin
ue
03DC 02C4
35 03DC 02C4 LINE (1,1)-(318,169),0,BF: 'erase graphics tablet
0401 02C4
0401 02C4 SHOWNEXT:
0406 02C4 DROWZ = ((I - 1) MOD 22) + 2: 'calculate row for disp
lay
40 0422 02C6 DCOLZ = 4: 'set column to 4
0429 02C8 IF ((I - 1) MOD 44) > 21 THEN DCOLZ = 23: 'reset column
if necessary
044C 02C8
044C 02C8 LINE INPUT #1, AS: 'read next name from directory
45 0459 02C8 LOCATE DROWZ,DCOLZ:PRINT AS; 'PRINT NAME
0475 02C8 GOTO DISLOOP
0479 02C8
0479 02C8 DIREXIT:
047E 02C8 CLOSE #1: 'terminate access to PATDIR.RJP
50 0485 02C8 GOTO FIRST
0489 02C8
0489 02C8 REM $PAGE

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Reagent Jet Printer  
Pattern Entry/Modification

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0469 0203 PATLOAD:
      046E 0203      GOSUB ITEMGOERASE: 'erase blue box around DIR
      0474 0203      OPEN "PATDIR.RJP" FOR INPUT AS #1
      0485 0203      INPUT #1,PATNUMZ: 'read number of patterns in dir
10     0487 0203      GOSUB GETNAME: 'prompt for and input pattern n
      048E 0203      ***
      04EB 0203      LINE (1,1)-(310,139),0,BF: 'erase graphics tablet
      04E2 0203
      04E2 0203      GOSUB SEARCH
15     04EB 0203      IF IZ < (PATNUMZ + 1) THEN GOTO FOUND
      04FC 0203      LOCATE 10,16-(LEN(NAMES)/2):PRINT NAMES;" not Found";
      0531 0203      LOCATE 12,14:PRINT "Strike Any Key"
      0548 0203      GOSUB ANYKEY: 'wait for a keyhit
20     0551 0203      GOTO FIRST
      0555 0203
      0555 0203      FOUND:
      055A 0203      FILES = RIGHTS(STR$(IZ),LEN(STR$(IZ))-1) + "PAT.RJP"
      057E 0203      OPEN FILES FOR INPUT AS #1: 'set pattern data file
25     058F 0203      for read
      058F 0203      INPUT #1,ELNUMZ: 'read number of elements in pat
      05A1 0203      tern
      05B3 0203      INPUT #1,GRID: 'read grid size
      05C5 0203      INPUT #1,REPEATZ: 'read repeat count
30     05D7 0203      INPUT #1,XOFF: 'read x axis offset for repeat
      05E9 0203      INPUT #1,YOFF: 'read y axis offset for repeat
      05E9 0203      FOR IZ = 0 TO ELNUMZ - 1
      05F7 0203      FOR JZ = 0 TO 5
35     05FD 0203      INPUT #1,SCADATZ(IZ,JZ): 'read file into screen
      0621 0203      array
      0631 0203      NEXT JZ
      0643 0203      NEXT IZ
      0643 0203      CLOSE #1: 'done with data file
40     064A 0203
      064A 0203      OPEN "PATDEF.RJP" FOR OUTPUT AS #1
      065C 0203      PRINT #1,FILES: 'save filename in defau
      066C 0203      lt file
      066C 0203      PRINT #1,NAMES: 'save the directory nam
45     067C 0203      e as well
      0683 0203      CLOSE #1
      0683 0203      GOTO REDRAW
      0687 0203
50     0687 0203      SEARCH:
      068C 0203      IZ = 1: 'set entry pointer
      0693 0203      SLOOP:
      0698 0203      LINE INPUT #1,AS: 'read next pattern name from di
      06A5 0203      IF AS = NAMES THEN GOTO SEARCH.END: 'compare name w
55     06B8 0203      ith dir entry
      06C1 0203      IZ = IZ + 1
      06C1 0203      IF IZ < (PATNUMZ + 1) THEN GOTO SLOOP: 'check for done
      06D4 0203      SEARCH.END:

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Reagent Jet Printer  
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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

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06D9 0226 CLOSE #1: 'not found so close file and display me  
ssage

06E0 0226 RETURN

06E4 02D6

06E4 02D6 IEM SPACE

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Reagent Jet Printer  
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IBM Personal Computer BASIC Compiler V2.00

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5      Offset Data Source Line
      06E4 02D6 PATSAVE:
      06E9 02D6      GOSUB ITEMEXTERASE: 'erase blue box around DIR
      06EF 02D6      IF ELNUMZ = 0 THEN GOTO FIRST: 'no elements in pattern
      06FE 02D6      OPEN "PATDIR.RJP" FOR INPUT AS #1
10     070F 02D6      INPUT #1,PATNUMZ
      0721 02D6      IF PATNUMZ < 60 THEN GOTO SAVE.PAT: 'directory full
                                at 80 patterns
      0730 02D6      CLOSE #1
      0737 02D6      LOCATE 25,1:PRINT SPACE$(39); 'erase bottom l
15                                ine
      0754 02D6      LOCATE 25,1:PRINT "Directory is full (80 patterns max)"
                                ;
      076E 02D6      GOSUB ANYKEY:GOTO FIRST
      0778 02D6      SAVE.PAT:
20     077D 02D6      GOSUB GETNAME: 'prompt for and get pattern name
      0783 02D6      GOSUB SEARCH
      0789 02D6      IF IZ > PATNUMZ THEN GOTO ADD.NEW.PATTERN
      079A 02D6      LINE (1,1)-(318,189),0,BF: 'erase graphics tablet
      07BF 02D6      LOCATE 10,13-(LEN(NAMES)/2):PRINT NAMES; 'already exist
25                                s.*;
      07F4 02D6      LOCATE 12,15:PRINT "Replace it?"
      080E 02D6      PATNUMZ = IZ
      0815 02D6      AS = ""
      081F 02D6      WHILE AS = ""
30                                AS = INKEY$
      082E 02D6      WEND
      0838 02D6      IF AS = "Y" OR AS = "y" THEN GOTO SAVE.PATTERN
      0844 02D6      GOTO FIRST
      0868 02D6
35     0868 02D6      ADD.NEW.PATTERN:
      086D 02D6      KILL "PATDIR.OLD": 'delete old backup directory
      0874 02D6      NAME "PATDIR.RJP" AS "PATDIR.OLD": 'save old direc
                                tory
      087E 02D6      OPEN "PATDIR.OLD" FOR INPUT AS #1
40     088F 02D6      OPEN "PATDIR.RJP" FOR OUTPUT AS #2: 'set up new dir
      08A1 02D6      INPUT #1,PATNUMZ: 'read number of dir entries
      08B3 02D6      PATNUMZ = PATNUMZ + 1: 'increase by 1
      08BC 02D6      WRITE #2,PATNUMZ: 'save in new directory
      08CD 02D6      FOR I=1 TO PATNUMZ - 1
45                                LINE INPUT #1,AS: 'read entry from old dir
      08E6 02DA      PRINT #2,AS: 'write entry in new directory
      08F3 02DA      NEXT I
      0903 02DA      PRINT #2,NAMES: 'write new entry to new directo
50                                ry
      092E 02DA      CLOSE #1:CLOSE #2: 'done with directory
      093C 02DA      SAVE.PATTERN:
      0941 02DA      FILES = RIGHTS(STR$(PATNUMZ),LEN(STR$(PATNUMZ))-1) + "P
                                AT.RJP"
      0965 02DA      OPEN FILES FOR OUTPUT AS #1: 'create new pattern dat
55                                a file
      0977 02DA      WRITE #1,ELNUMZ: 'store number of elements
      0988 02DA      WRITE #1,GRID: 'store grid dimension
      0998 02DA      WRITE #1,REPEATS: 'store repeat count
      09A9 02DA      WRITE #1,XOFF: 'store x axis offset for repeat

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Reagent Jet Printer  
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Offset Data Source Line IEN Personal Computer BASIC Compiler V2.00

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09E9 02DA WRITE #1,YOFF: 'store y axis offset for repeat  
09C9 02DA FOR IZ = 0 TO ELNUNT - 1  
09D7 02DC FOR JZ = 0 TO 5  
09D8 02DC WRITE #1,SCNDATZ(IZ,JZ): 'write screen a

30

0A00 02DC rray to file  
0A10 02DC NEXT JZ  
0A22 02DC NEXT IZ  
0A29 02DC CLOSE #1: 'done with data file  
0A3B 02DC OPEN "PATDEF.RJP" FOR OUTPUT AS #1  
0A3B 02DC PRINT #1,FILES: 'save filename in defau

35

0A4B 02DC lt file  
0A4B 02DC PRINT #1,NAME\$: 'save the directory naa  
e as well

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0A5B 02DC CLOSE #1  
0A62 02DC GOTO FIRST  
0A66 02DC REM SPAGE

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Resident Jet Printer  
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

```

5      Offset Data      Source Line
      0A69 02DC      PATTERN:
      0A6B 02DC      GOSUB ITEMBOIERASE
      0A71 02DC      LINE (1,1)-(318,189),0,8F:      'Erase graphics tablet
10     0A96 02DC      NEXTEL:
      0A9B 02DC      MENUMUM = 2
      0AAS 02DC      GOSUB SUBMENU
      0AAB 02DC
      0AAB 02DC      ON ITEM + 1 GOTO ALINE, RECT, SRECT, ACIRCLE, REDRAW, B
15     ACKUP
      0ACB 02DC      GOTO NEXTEL
      0ACB 02DC
      0ACB 02DC      BACKUP:
20     0AD0 02DC      GOSUB ITEMBOIERASE
      0AD6 02DC      GOTO FIRST
      0ADA 02DC
      0ADA 02DC      ALINE:
      0ADF 02DC      TEMP1 = 1
      0AE6 02DC      STARTMSG = 'STARTING ENDPOINT'
25     0AF0 02E2      ENDMSG = 'ENDING ENDPOINT'
      0AFA 02E6      GOTO ENTERELEMENT
      0AFE 02E6
      0AFE 02E6      RECT:
30     0B03 02E6      TEMP1 = 2
      0B0A 02E6      GOTO RECTMSG
      0B0E 02E6
      0B0E 02E6      SRECT:
      0B13 02E6      TEMP1 = 3
35     0B1A 02E6      RECTMSG:
      0B1F 02E6      STARTMSG = 'STARTING CORNER'
      0B29 02E6      ENDMSG = 'ENDING CORNER'
      0B33 02E6      GOTO ENTERELEMENT
      0B37 02E6
40     0B37 02E6      ACIRCLE:
      0B3C 02E6      TEMP1 = 4
      0B43 02E6      STARTMSG = 'CENTER OF CIRCLE'
      0B4B 02E6      ENDMSG = 'POINT ON CIRCLE'
      0B57 02E6
45     0B57 02E6      ENTERELEMENT:
      0B5C 02E6      GOSUB ITEMBOIERASE
      0B62 02E6      FLAG1=0
      0B69 02EB      LOCATE 25,1:PRINT SPACE$(39);
      0B66 02EB      LOCATE 25,1:PRINT STARTMSG;
50     0BA0 02EB      GOSUB DISPCURSOR
      0BA6 02EB      FINDSTART:
      0BAB 02EB      GOSUB MOUSEACT
      0BB1 02EB      IF AS = CHR$(27) THEN GOTO ASORT
      0BC3 02EB      IF AS = CHR$(13) THEN GOTO SETSTART
      0BCF 02EB      GOSUB CURSORMOVE
55     0BE5 02EB      GOTO FINDSTART
      0BE2 02EB      ASORT:
      0BED 02EB      GOSUB PLACECURSOR
      0BF3 02EB      GOTO NEXTEL
      0BF7 02EB

```

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Reagent Jet Printer  
Pattern Entry/Modification

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10:46:13

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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08F7 02EB SETSTART:
08FC 02EB LOCATE 25,1:PRINT ENUNSE8:
0C16 02EB FLAG% = TEMP1:11% = 12:Y1% = Y2
20 0C2B 02EC IF FLAG% = 4 THEN PSET (12+4,Y2+4)
0C35 02EC FINDEND:
0C5A 02EC GOSUB MOUSEACT
0C60 02EC IF AS = CHR$(27) THEN GOTO CANCELEL
0C77 02EC IF AS = CHR$(13) THEN GOTO SAVEEL
25 0C8E 02EC GOSUB CURSORMOVE
0C94 02EC GOTO FINDEND
0C97 02EC CANCELEL:
0C9C 02EC GOSUB PLACECURSOR
0CA2 02EC ON FLAG% GOSUB ER1, ER2, ER3, ER4
0CB3 02EC FLAG% = 0
30 0CBA 02EC GOTO NEXTEL
0CBE 02EC SAVEEL:
0CC3 02EC GOSUB PLACECURSOR
0CC9 02EC IF FLAG% = 4 THEN CIRCLE (12+4,Y2+4),SQR((12-11%)^2+(
35 Y2-Y1%)^2),,,,1
0D32 02EC GOSUB CORRECT
0D3B 02EC IF AS="N" THEN GOTO REDRAW
0D4B 02EC STOREEL:
0D50 02EC SCONDAT%(ELNUM%,0) = FLAG%
0D6A 02EC SCONDAT%(ELNUM%,1) = 11%
40 0D85 02EC SCONDAT%(ELNUM%,2) = Y1%
0DA0 02EC SCONDAT%(ELNUM%,3) = 1%
0D9B 02EC SCONDAT%(ELNUM%,4) = Y2
0DD6 02EC SCONDAT%(ELNUM%,5) = 0
45 0DEF 02EC ELNUM% = ELNUM% + 1
0DFB 02EC FLAG% = 0
0DFF 02EC GOTO NEXTEL
0E03 02EC REN SPAGE

```

Reagent Jet Printer  
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler v2.00

```

5      Offset Data      Source Line
      0E03 02EC      REDRAW:
      0E08 02EC          GOSUB ITEMBOYERASE
      0E0E 02EC          LINE(1,1)-(318,189),0,3F
      0E33 02EC          IF ELNUM2 = 0 THEN GOTO NEXTEL
10     0E42 02EC
      0E42 02EC          FOR I=0 TO ELNUM2-1
      0E5B 02F0          ON SCNDATX(1,0) GOSUB RD1, RD2, RD3, RD4
      0E81 02F0          NEXT I
      0E9C 02F0          GOTO NEXTEL
15     0EA0 02F0
      0EA0 02F0          ***** Sub-routines called by main module *****
      0EA0 02F0
      0EA0 02F0      SUSMENU:
      0EAS 02F0
20     0EAS 02F0          LOC:      1:PRINT SPACES(39);
      0EC2 02F0          ON 1: GOSUB MENU1, MENU2
      0ED1 02F0
      0ED1 02F0          FOR I= 1 6
      0EDB 02F0          READ MENU(1)
25     0EF2 02F0          LOCATE 25,(116)+2:PRINT MENU(1);
      0F1B 02F0          NEXT I
      0F46 02F0
      0F46 02F0          READ MAXITEM
      0F4D 02F4          ITEM = 0
30     0F57 02F4
      0F57 02F4      NEWITEM:
      0F5C 02F4          GOSUB NEWITEMBOX
      0F62 02F4
      0F62 02F4      NEXTITEM:
35     0F67 02F4          GOSUB ITEMSEARCH
      0F6D 02F4          IF AS = CHR$(13) THEN RETURN: ITEM has correct value
      0F84 02F4          IF LEN(AS) < 2 THEN BEEP:GOTO NEXTITEM
      0F9A 02F4          IF ASC(AS$(AS,2,1)) = 75 THEN GOTO LEFTAR
      0F96 02F4          IF ASC(AS$(AS,2,1)) = 77 THEN GOTO RIGHTAR
40     0FD2 02F4          BEEP:GOTO NEXTITEM
      0FD9 02F4
      0FD9 02F4      LEFTAR:
      0FDE 02F4          IF ITEM = 0 THEN GOTO NEXTITEM
      0FEE 02F4          GOSUB ITEMBOYERASE
45     0FF4 02F4          ITEM = ITEM - 1
      1003 02F4          GOTO NEWITEM
      1007 02F4
      1007 02F4      RIGHTAR:
      100C 02F4          IF ITEM = MAXITEM THEN GOTO NEXTITEM
50     101F 02F4          GOSUB ITEMBOYERASE
      1025 02F4          ITEM = ITEM + 1
      1034 02F4          GOTO NEWITEM
      1038 02F4
      1038 02F4      MENU1:
55     103D 02F4          RESTORE MN1
      1044 02F4          RETURN
      1048 02F4
      1048 02F4      MENU2:
      104D 02F4          RESTORE MN2

```

Reagent Jet Printer  
Pattern Entry/Modification

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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5      1054 02F4      RETURN
      1058 02F4
      1059 02F4      ITEMSEARCH:
      1060 02F4      AS = INKEY$: IF AS < > ** THEN RETURN
10     1074 02F4      GOTO ITEMSEARCH
      1070 02F4      RETURN
      1081 02F4
      1081 02F4      NEWITEMBOX:
      1086 02F4      IX = (ITEM+48) + 7
15     109C 02FB      IY = (ITEM+48) + 8 + LEN(MENUS(ITEM))+8
      1009 02FC      LINE (IX,191)-(IY,199),1,8
      1101 02FC      RETURN
      1105 02FC
      1105 02FC      ITEMBOXERASE:
20     110A 02FC      LINE (IX,191)-(IY,199),0,8
      1131 02FC      RETURN
      1135 02FC
      1135 02FC      PLACECURSOR:
      113A 02FC      PUT (IX+1,IY+1),CURSOR:
25     1157 02FC      RETURN
      1158 02FC
      1158 02FC      MOUSEACT:
      1160 02FC      GOSUB ANYKEY
      1166 02FC      DXZ = 0 : DYZ = 0
30     1174 0300      IF AS = CHR$(10) + CHR$(72) THEN DYZ = -1:RETURN
      119D 0300      IF AS = CHR$(10) + CHR$(160) THEN DYZ = 1:RETURN
      11C6 0300      IF AS = CHR$(10) + CHR$(77) THEN DXZ = 1:RETURN
      11EF 0300      IF AS = CHR$(10) + CHR$(75) THEN DXZ = -1:RETURN
      1218 0300      IF AS = "B" THEN DYZ = -20:RETURN
35     1232 0300      IF AS = "Z" THEN DYZ = 20:RETURN
      124C 0300      IF AS = "4" THEN DXZ = -20:RETURN
      1266 0300      IF AS = "6" THEN DXZ = 20:RETURN
      1280 0300      IF AS = CHR$(27) THEN RETURN
      1297 0300      IF AS = CHR$(13) THEN RETURN
40     12AE 0300      GOTO MOUSEACT
      1292 0300
      1282 0300      CURSORMOVE:
      1287 0300      GOSUB PLACECURSOR
      128D 0300      ON FLAGZ GOSUB ER1, ER2, ER3, ER4
45     12CE 0300      IX = IX + DXZ : IY = IY + DYZ
      12EA 0300      IF IX < 0 THEN IX = 0
      12FB 0300      IF IX > 311 THEN IX = 311
      1308 0300      IF IY < 0 THEN IY = 0
      131D 0300      IF IY > 182 THEN IY = 182
50     1330 0300      ON FLAGZ GOSUB DR1, DR2, DR3, DR4
      1341 0300      GOSUB DISPCURSOR
      1347 0300      RETURN
      1348 0300
      1348 0300      CORRECT:
55     1350 0300      LOCATE 25,1:PRINT SPACES(39);
      136D 0300      LOCATE 25,1:PRINT "IS THIS CORRECT? (Y or N) ";
      1387 0300      CORLOOP:
      138C 0300      GOSUB ANYKEY
      1392 0300      IF AS = "Y" OR AS = "Y" THEN AS = "Y":GOTO CORRECT

```



Reagent Jet Printer  
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
1305	0300	IF AS = 'n' OR AS = 'N' THEN AS = 'N':GOTO COREXIT
1308	0300	GOTO CORLOOP
1308	0300	COREXIT:
1400	0300	LOCATE 25,1:PRINT SPACE(39);
1410	0300	RETURN
1421	0300	
1421	0300	DISPCURSOR:
1425	0300	GOSUB PLACECURSOR
1426	0300	LOCATE 25,27:PRINT USING "+0.000";IX + GRID;
1456	0300	PRINT " ";
1463	0300	PRINT USING "+0.000";YI + GRID;
1460	0300	RETURN
1484	0300	
1484	0300	
1489	0300	R01:
1522	0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN
1526	0300	DATZ(I,4)+4)
1526	0300	RETURN
1528	0300	R02:
1528	0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN
1528	0300	DATZ(I,4)+4),,B
1528	0300	RETURN
1504	0300	
1508	0300	
1508	0300	R03:
1508	0300	LINE(SCNDATZ(I,1)+4,SCNDATZ(I,2)+4)-(SCNDATZ(I,3)+4,SCN
1508	0300	DATZ(I,4)+4),,BF
1508	0300	RETURN
1667	0300	
1668	0300	
1668	0300	R04:
1670	0300	RADIUSZ = SQR((SCNDATZ(I,3)-SCNDATZ(I,1))^2 + (SCNDATZ(I,
1670	0300	4)-SCNDATZ(I,2))^2)
1670	0300	CIRCLE (SCNDATZ(I,1)+4,SCNDATZ(I,2)+4),RADIUSZ,,,1
1670	0300	RETURN
1750	0302	
1750	0302	
1761	0302	CR1:
1761	0302	LINE (XI2+4,YI2+4)-(I2+4,YI2+4)
1766	0302	RETURN
17AF	0302	
17B3	0302	
17B3	0302	CR2:
17B8	0302	LINE (XI2+4,YI2+4)-(I2+4,YI2+4),,B
1801	0302	RETURN
1805	0302	
1805	0302	CR3:
180A	0302	LINE (XI2+4,YI2+4)-(I2+4,YI2+4),,BF
1854	0302	RETURN
1858	0302	
1858	0302	CR4:
185D	0302	RETURN
1861	0302	
1861	0302	CR1:
1866	0302	LINE (XI2+4,YI2+4)-(I2+4,YI2+4),0
18AF	0302	RETURN
18B3	0302	

Reagent Jet Printer  
Pattern Entry/Modification

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IBM Personal Computer BASIC Compiler V2.00

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1883 0302  ER2:
1888 0302      LINE (X12+4,Y12+4)-(X2+4,Y2+4),0,B
1901 0302      RETURN
1905 0302
1905 0302  ER3:
190A 0302      LINE (X12+4,Y12+4)-(X2+4,Y2+4),0,BF
1954 0302      RETURN
1958 0302
1959 0302  ER4:
195D 0302      RETURN
1961 0302
1961 0302  INKEY:
1965 0302      AS = ""
1970 0302      WHILE AS = ""
197F 0302          AS = INKEY$
1989 0302      WEND
199C 0302      RETURN
1990 0302
1990 0302  SETNAME:      'prompt for and get filename'
1995 0302      LOCATE 25,1:PRINT SPACES(39);
1997 0302      LOCATE 25,38:PRINT "<<";      'boundary chevron
19CC 0302      LOCATE 25,1:PRINT "Enter Pattern Name ";
19E6 0302      LINE INPUT; "",NAME$
19F4 0302      RETURN
19FB 0302
19FB 0302      ' Data fields used by this module
19FB 0302
19FB 0302  "41:
19FD 0302      DATA "DIR","LOAD","SAVE","DRAW","REPT","EXIT","",5
19FF 0302
19FF 0302  "N2:
1A04 0302      DATA "LINE","RECT","ERECT","CIRCL","SEDRN","MAIN","",5
1A06 0302
1A06 0302  INSTRU:
1A08 0302      DATA 8,16,"USE ARROWS"
1A0D 0302      DATA 10,9,"TO SELECT FROM THE MENU"
1A0F 0302      DATA 14,12,"USE THE ENTER KEY"
1A11 0302      DATA 16,10,"TO ACTIVATE SELECTION"
1A13 0302
1A13 0302  END SUB
1A1A 0302
21AF 0302

```

50426 Bytes Available  
43373 Bytes Free

0 Warning Error(s)  
0 Severe Error(s)

Reagent Jet Printer  
Burr-Brown PCI-20000 custom driver

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02:33:16

```

5      Offset Data   Source Line
      0030 0006  REM TITLE: 'Reagent Jet Printer'  SUBTITLE: 'Burr-Brown PCI-2000
      0030 0006  0 custom driver'
      0030 0006  'MODULE - 'PCI' Driver for the PCI-20000 I/O and PULSE cards
10     0030 0006  'AUTHOR - M. S. Fairchild of Computing Architects Inc.
      0030 0006  113 Fairfield Way
      0030 0006  Bloomingdale, IL 60108
      0030 0006  312/980-6777
15     0030 0006  'COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006  'REVISION - 1.2 12-16-85 MSF Add digital I/O initialization, and
      0030 0006  output routine
      0030 0006  .
20     0030 0006  . - 1.1 12-10-85 MSF Move counter module to position 2
      0030 0006  .
      0030 0006  . - 1.0 11-22-85 MSF Creation of initial code
      0030 0006  .
25     0030 0006  'SYSTEM - This code can only be compiled by the BASCOM V2
      0030 0006  'COMPILER, it will not run under the INTERPRETER!!
      0030 0006  'DESCRIPTION:
      0030 0006  The PCI module is a group of routines used to a
30     0030 0006  ccess
      0030 0006  the BURR-Brown PCI-20000 board. The supplied software c
      0030 0006  auses
      0030 0006  the Wordstar2000 software to malfunction and will not p
      0030 0006  rvide
35     0030 0006  ivers
      0030 0006  explicit on, off functions for the counters. Custom dr
      0030 0006  will be able to provide all of the desired functions.
      0030 0006  .
40     0030 0006  Address Register
      0030 0006  &HC0000 Carrier I.D. / module present (R)
      0030 0006  &HC0040 Module interrupt status (R)
      0030 0006  &HC0080 Digital I/O port 0 (R/W)
      0030 0006  &HC0081 Digital I/O port 1 (R/W)
45     0030 0006  &HC0082 Buffer direction and enable (R/W)
      0030 0006  &HC0083 Control for ports 0 and 1 (W)
      0030 0006  &HC00C0 Digital I/O port 2 (R/W)
      0030 0006  &HC00C1 Digital I/O port 3 (R/W)
      0030 0006  &HC00C3 Control for ports 2 and 3 (W)
50     0030 0006  &HC0200 Read module I.D. (1110 1010)
      0030 0006  &HC0204 Rate generator low-order 16 bits (0)
      0030 0006  &HC0205 Rate generator high-order 16 bits (1)
      0030 0006  &HC0206 Counter 3 count register (2)
      0030 0006  &HC0207 Rate generator/counter 3 control
55     0030 0006  &HC0208 Counter 0 count register (0)
      0030 0006  &HC0209 Counter 1 count register (1)
      0030 0006  &HC020A Counter 2 count register (2)
      0030 0006  &HC020B Counter 0 - 2 control
      0030 0006  &HC020C Counter gate control (1 enables, 0 disa

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Resident Jet Printer  
Burr-Brown PDI-00000 custom driver

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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Offset	Data	Source Line	bit	function
0030	0006	.	0	Rate generator gate
0030	0006	.	1	Rate generator gate
0030	0006	.	2	Counter 0 gate
0030	0006	.	3	Counter 1 gate
0030	0006	.	4	Counter 2 gate
0030	0006	.	5	Counter 3 gate
0030	0006	.	6	Not used
0030	0006	.	7	Not used

25

0030 0006 DATA DICTIONARY

0030 0006 COUNT - Divisor to 2Mhz rate to give desired frequency or time

0030 0006 COUNTHZ - High order 16 bits of a 32 bit divisor

0030 0006 COUNTLZ - Low order 16 bits of a 32 bit divisor

0030 0006 LSBZ - Lower 8 bits of a 16 bit divisor

0030 0006 MSBZ - Upper 8 bits of a 16 bit divisor

35

0030 0006 Main line code

0030 0006 The main line code is never executed. It's sole purpose is to

40

0030 0006 declare shared the variables that will be used in the subroutine lines

0030 0006 so that they will all be defined and hold their values.

45

0030 0006 MAIN:

0030 0006 DIM SHARED COUNT,COUNTHZ,COUNTLZ,LSBZ,MSBZ

0030 0006 MAINLOOP:

0030 0006 GOTO MAINLOOP

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0040 0012 REM \$PAGE

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Reagent Jet Printer  
Burr-Brown PCI-20000 custom driver

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0040 0012 SUBROUTINE - PCI.INIT
      0040 0012
      0040 0012 DESCRIPTION:
      0040 0012 The PCI.INIT subroutine initializes the PCI hardware.
10     0040 0012 SUB PCI.INIT STATIC
      0053 0012
      0053 0012 DEF SEE = LHC000: 'Point segment to PCI-20000 board
      005A 0012
15     005A 0012 POKE LHC00C,&H00: 'Disable all software enabled counter
      5
      0063 0012
      0063 0012 Configure rate generator to 2 Mhz
      0063 0012
20     0063 0012 POKE &H0207,&H34: 'Set low rate counter to mode 2
      006D 0012 POKE &H0207,&H74: 'Set high rate counter to mode 2
      0077 0012 POKE &H0204,&H02: 'Load low rate counter with 16 bits 0
      f 2
      0081 0012 POKE &H0204,&H00
25     008A 0012 POKE &H0205,&H02: 'Load high rate counter with 16 bits
      of 2
      0094 0012 POKE &H0205,&H00
      009D 0012 POKE &H020C,&H03: 'Enable rate counters
      00A7 0012
30     00A7 0012 Configure dot rate counters (default to 5 Khz)
      00A7 0012
      00A7 0012 POKE &H0209,&H34: 'Set low dot counter (0) to mode 2
      00B1 0012 POKE &H0209,&H74: 'Set high dot counter (1) to mode 2
      00BB 0012 POKE &H0206,&H04: 'Load low rate counter with 16 bits 0
35     f 4
      00C3 0012 POKE &H0209,&H00
      00CE 0012 POKE &H0209,&H64: 'Load high rate counter with 16 bits
      of 100
      00D8 0012 POKE &H0209,&H00
40     00E1 0012
      00E1 0012 Configure dot pulse with one shot (default to 13 usec)
      00E1 0012
      00E1 0012 POKE &H0209,&H82: 'Set dot pulse with oneshot (2) to mo
      de 1
45     00EB 0012 POKE &H020A,&H1A: 'Load oneshot with 16 bits of 26
      00F3 0012 POKE &H020A,&H00
      00FE 0012
      00FE 0012 Configure shifted strobe pulse one shot (default to .5 usec)
      00FE 0012
50     00FE 0012 POKE &H0207,&H82: 'Set shifted strobe onshot (3) to mod
      e 1
      0106 0012 POKE &H0206,&H01: 'Load oneshot with 16 bits of 1
      0112 0012 POKE &H0206,&H00
      011B 0012
55     011B 0012 Configure port 0 to output and port 1 to input
      011B 0012
      011B 0012 POKE &H0083,&H52: 'Set up I/O chip
      0125 0012 POKE &H0082,&H34: 'Set up direction and enable buffers
      012F 0012 POKE &H0080,&H00: 'Disable print head

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Reagent Jet Printer  
 Burr-Brown PCM-20000 custom driver

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

0136 0012      END SUB
013F 0012
20 013F 0012  REM $PAGE1F:12
013F 0012  SUBROUTINE      - DOT.ON
013F 0012
013F 0012  DESCRIPTION:
013F 0012      The DOT.ON subroutine enables the dot frequency counter
25 013F 0012
013F 0012  SUB DOT.ON STATIC
0146 0012
0146 0012      POKE &H020C,&H0F: 'Enable dot counters and rate generat
30 or
0150 0012
0150 0012      END SUB
0157 0012
0157 0012  REM $PAGE1F:12
35 0157 0012  SUBROUTINE      - DOT.CFF
0157 0012
0157 0012  DESCRIPTION:
0157 0012      The DOT.CFF subrou : disables the dot counters
40 0157 0012  SUB DOT.CFF STATIC
015E 0012
015E 0012      POKE &H020C,&H03: 'Disable dot counters and enable rate
generator
0162 0012
45 0162 0012      END SUB
016F 0012
016F 0012  REM $PAGE1F:49

```

Reagent Jet Printer  
Burr-Brown PCI-20000 custom driver

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08:38:16

```

5      Offset: Data      Source Line      IBM Personal Computer BASIC Compiler V2.00

      016F 0012  SUBROUTINE - SET.DOT.RATE
      016F 0012
10     016F 0012  DESCRIPTION:
      016F 0012      The SET.DOT.RATE subroutine loads the dot rate counters
      016F 0012      with the desired dot frequency. Allowed range is 10,000 to 1
      016F 0012      Hz.
      016F 0012      The FREQ parameter is a real number in Hz.
15     016F 0012
      016F 0012  SUB SET.DOT.RATE(FREQ) STATIC
      0176 0012
      0176 0012      Limit frequency to in range
      0176 0012
20     0176 0012      IF FREQ < 1 THEN FREQ = 1
      018F 0012      IF FREQ > 10000 THEN FREQ = 10000
      01A8 0012
      01A8 0012      Convert to count and check for 16 bit count or 32 bit count
      01A8 0012
25     01A8 0012      COUNT = 256 / FREQ
      01B8 0012      IF COUNT < 65536 THEN GOTO DIVIDE16 ELSE GOTO DIVIDE32
      01CF 0012
      01CF 0012      Process count of 32 bits
      01CF 0012
30     01CF 0012  DIVIDE32:
      01D0 0012      COUNTLZ = INT((COUNT/32768) + .5): 'Stage lower count
      01F0 0012      COUNTHZ = INT(COUNT/COUNTLZ): 'Form upper count
      0208 0012      GOTO SET.COUNT
      020F 0012
35     020F 0012      Process count of 16 bits
      020F 0012
      020F 0012  DIVIDE16:
      0214 0012      COUNTLZ = 2
      021B 0012      COUNTHZ = INT(COUNT/2)
40     0232 0012      GOTO SET.COUNT
      0236 0012
      0236 0012      Send the derived counts out to the counters
      0236 0012
      0236 0012  SET.COUNT:
45     0237 0012      LSBZ = COUNTLZ MOD 256: 'Send out low 16 bits
      0248 0012      MSBZ = INT(COUNTLZ / 256)
      0263 0012      POKE &H0208,LSBZ
      0273 0012      POKE &H0208,MSBZ
      0283 0012
50     0283 0012      LSBZ = COUNTHZ MOD 256: 'Send out high 16 bits
      0291 0012      MSBZ = INT(COUNTHZ / 256)
      02AC 0012      POKE &H0209,LSBZ
      02BC 0012      POKE &H0209,MSBZ
      02CC 0012
55     02CC 0012      END SUB
      02D3 0012
      02D3 0012  REM $PAGEIF:27

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Reagent Jet Printer  
Burr-Brown PCI-20000 custom driver

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IBM Personal Computer BASIC Compiler V2.00

```

Offset  Data  Source Line
02D3  0012  SUBROUTINE - SET.DOT.WIDTH
02D3  0012  '
20 02D3  0012  'DESCRIPTION:
02D3  0012  ' The SET.DOT.WIDTH subroutine loads the dot width one sh
    ' at
02D3  0012  ' with the desired dot pulse width. Allowed range is .5 to 16,0
    ' 00 usec.
25 02D3  0012  ' The dwidth parameter is a real number in usec.
02D3  0012  '
02D3  0012  SUB SET.DOT.WIDTH(DWIDTH) STATIC
02DA  0012  '
02DA  0012  ' Limit width to in range
30 02DA  0012  '
02DA  0012  IF DWIDTH < .5 THEN DWIDTH = .5
02F3  0012  IF DWIDTH > 16000 THEN DWIDTH = 16000
030C  0012  '
030C  0012  ' Convert to count
35 030C  0012  '
030C  0012  COUNT = DWIDTH / .5
031A  0012  '
031A  0012  ' Send the derived count out to the counter
031A  0012  '
40 031A  0012  LSBZ = INT(COUNT MOD 256): ' Send out 16 bits
0331  0012  MSBZ = INT(COUNT / 256)
0348  0012  POKE &H020A,LSBZ
0358  0012  POKE &H020A,MSBZ
0368  0012  '
45 0368  0012  END SUB
036F  0012  '
036F  0012  REM $PAGE$F:27

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Reagent Jet Printer  
Burr-Brown PDI-20000 custom driver

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08:38:16

IBM Personal Computer BASIC Console V2.00

```

5      Offset Data Source Line
      036F 0012 SUBROUTINE - SET.STROBE.DELAY
      036F 0012
      036F 0012 DESCRIPTION:
10     036F 0012 The SET.STROBE.DELAY subroutine loads the strobe delay
      one shot
      036F 0012 with the desired strobe delay time. Allowed range is .5 to 16
      ,000 usec.
      036F 0012 The delay parameter is a real number in usec.
15     036F 0012
      036F 0012 SUB SET.STROBE.DELAY(DELAY) STATIC
      0376 0012
      0376 0012 Limit delay to in range
      0376 0012
20     0376 0012 IF DELAY < .5 THEN DELAY = .5
      036F 0012 IF DELAY > 16000 THEN DELAY = 16000
      03A8 0012
      03A8 0012 Convert to count
      03A8 0012
25     03A8 0012 COUNT = DELAY / .5
      03B6 0012
      03B6 0012 Send the derived count out to the counter
      03B6 0012
      03B6 0012
30     03B6 0012 LSBZ = INT(COUNT MOD 256): Send out 16 bits
      03CD 0012 MSBZ = INT(COUNT / 256)
      03E4 0012 POKE &H0206,LSBZ
      03F4 0012 POKE &H0206,MSBZ
      0404 0012
      0404 0012 END SUB
35     0408 0012
      0408 0012 REM SPAGE1F:16
      0408 0012 SUBROUTINE - DIGITAL.OUT
      0408 0012
      0408 0012 DESCRIPTION:
40     0408 0012 The DIGITAL.OUT subroutine sends the passed integer to
      the output
      0408 0012 port 0.
      0408 0012
      0408 0012 SUB DIGITAL.OUT(BYTEZ) STATIC
45     0412 0012
      0412 0012 Send the byte to the port
      0412 0012
      0412 0012 POKE &H0080,BYTEZ
      0423 0012
50     0423 0012 END SUB
      042A 0012
      057F 0012

```

50426 Bytes Available

48723 Bytes Free

0 Warning Error(s)  
0 Severe Error(s)

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Reagent Jet Printer  
Pattern Printing

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IBM Personal Computer BASIC Compiler V

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10  Offset Data Source Line
      0030 0006 REM TITLE: 'Reagent Jet Printer' SSUBTITLE: 'Pattern Printing' SLINESIZE:102
      0030 0006 MODULE - 'PATTERN'
      0030 0006
      0030 0006 AUTHOR - M. A. Enavold
      0030 0006
15  0030 0006 COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006
      0030 0006 REVISION - 2.0 07-02-86 MAE Modified for MicroFab Printhead
      0030 0006 - 1.1 03-07-86 MAE Added notes and final touches
      0030 0006 1.0 02-03-86 MAE Creation of initial code
      0030 0006
20  0030 0006 SYSTEM - This code can only be compiled by the BASCOM
      0030 0006 COMPILER, it will not run under the INTERPRETER!!
      0030 0006
      0030 0006 DESCRIPTION:
      0030 0006 The printing module displays a menu in 3 columns of 4 rows each. The first
25  0030 0006 column has data from the default reagent profile. The second column has
      0030 0006 data from the default pattern file. The third column has standard printing
      0030 0006 data. The four arrow keys allow different menu items to be highlighted and
      0030 0006 the values can be changed with the + or - keys or by entering the new number
      0030 0006 followed by Enter. P will cause the pattern to be printed, S will select the
      0030 0006 notepad, and E will exit to the main program. On the notepad, any single line
30  0030 0006 entered here will be sent to the printer. A null line exits the notepad.
      0030 0006
      0030 0006 DATA DICTIONARY
      0030 0006 MENUZ Which menu item is highlighted (0-17)
      0030 0006 DIFFZ where to move menu highlight in response to arrow key
      0030 0006 TYPEZ what key has been pressed during main scan
35  0030 0006 ELCTRZ Number of elements in current pattern
      0030 0006 SOLDATA(00,5) Array for storing elements in current pattern
      0030 0006 REPEATZ Counter for repeat printing the pattern
      0030 0006 CTZ Counter for stepping through the pattern array during printing
      0030 0006 RADIUSZ Radius of circle during printing
      0030 0006 IX IZ Offsets for start row/column position
40  0030 0006 REPIZ REPIZ Repeat distances for repeat printing of patterns
      0030 0006 SIZ SYZ Starting I and Y positions for solid rectangles
      0030 0006 EIZ EYZ Ending I and Y positions for solid rectangles
      0030 0006 IZ JZ Counters used for reading pattern files into the array
      0030 0006 TEMPZ Register for disc. integers
      0030 0006 NOTELINEZ Pointer to which line is active in the notepad
45  0030 0006 MENU(17,1) Array of strings used to display menu items
      0030 0006 AS Single keystroke input destination
      0030 0006 NOTES String entered in notepad and sent to printer
      0030 0006 KEYBUFZ String entered from main scan and assigned to number of string field
      0030 0006 REAGENTZ Name of default reagent
      0030 0006 PATTERNZ Name of default pattern
50  0030 0006 FILES Name of reagent data file and then pattern data file
      0030 0006 REVAL(11,4) Array of values used in displaying menu item numbers
      0030 0006 TEMP Register for the temporary storage of real numbers
      0030 0006 REM SPACE

```

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5 Request Set Printer  
Pattern Printing

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IBM Personal Computer BASIC Compiler V.

Offset	Data	Source Line
10 0036	0036	SUB PATPRINT STATIC
0047	0047	
0047	0047	DIR SCHOATC(50.5),MENU(17,1),MENU(17,4)
0048	0462	
0048	0462	SOSUB INITIALIZE: 'read init. values and set screen
004E	0462	
004E	0462	WHILE TYPEZ < 1
15 0059	0464	
0059	0464	TYPEZ = 0
0060	0464	AS = ""
006A	0468	
006A	0468	WHILE AS = ""
0079	0468	AS = INKEYS
20 0083	0468	WEND
0086	0468	
0086	0468	IF AS = "E" OR AS = "e" THEN TYPEZ = 1: 'exit sub
008E	0468	IF AS = "P" OR AS = "p" THEN TYPEZ = 2: 'print pattern
008E	0468	IF AS = "+" THEN TYPEZ = 3: 'increment variable
25 00F4	0468	IF AS = "-" THEN TYPEZ = 4: 'decrement variable
010A	0468	IF AS = CHR\$(10) + CHR\$(72) THEN TYPEZ = 5: 'up arrow key
012F	0468	IF AS = CHR\$(10) + CHR\$(80) THEN TYPEZ = 6: 'down arrow key
0154	0468	IF AS = CHR\$(10) + CHR\$(75) THEN TYPEZ = 7: 'left arrow key
0179	0468	IF AS = CHR\$(10) + CHR\$(77) THEN TYPEZ = 8: 'right arrow key
019E	0468	IF AS > CHR\$(47) AND AS < CHR\$(58) THEN TYPEZ = 9: 'number 0-9
30 01D6	0468	IF AS = "S" OR AS = "s" THEN TYPEZ = 10: 'enter scratchpad
0202	0468	
0202	0468	ON TYPEZ GOSUB T1, T2, T3, T4, T5, T6, T7, T8, T9, T10
021F	0468	
021F	0468	WEND
0225	0468	TYPEZ = 0
35 022A	0468	
022A	0468	EXIT SUB
022E	0468	
022E	0468	***** SUBROUTINES FOR THIS MODULE *****
022E	0468	T10: 'scratch pad
0233	0468	SCREEN 0,0,0,2:COLOR 7,0
40 0256	0468	LOCATE NOTELINEZ,1
0264	046A	NOTELCOP:
0269	046A	LINE INPUT NOTES
0277	046E	IF NOTES = "" THEN SCREEN 0,0,0,0:RETURN
029F	046E	LPRINT NOTES
02AC	046E	IF NOTELINEZ < 24 THEN NOTELINEZ = NOTELINEZ + 1
45 02C0	046E	GOTO NOTELCOP
02C3	046E	
02C3	046E	
02C3	046E	T1:
02C3	046E	RETURN: 'exit to print menu, no action
02C3	046E	
50 02C3	046E	T3:
02C3	046E	'process "+" key
02C3	0470	IF MENU(MENUZ,0) > MENU(MENUZ,1) THEN MENU(MENUZ,0) = MENU(MENUZ,1):RETURN: 'check max value
02C3	0470	MENU(MENUZ,0) = MENU(MENUZ,0) + MENU(MENUZ,3): 'add increment
02C3	0470	COLOR 0,7:GOSUB DISPMENU:RETURN: 'show new value
02C3	0470	
55 02C3	0470	T4:
		'process "-" key

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Pattern Printing

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IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
036C	0470	IF MENU(MENUZ,0) <= MENU(MENUZ,2) THEN MENU(MENUZ,0) = MENU(MENUZ,2):RETURN: 'check min value
03F2	0470	MENU(MENUZ,0) = MENU(MENUZ,0) - MENU(MENUZ,3): 'sub increment
042E	0470	COLOR 0,7:GOSUB DISPMENU:RETURN: 'show new value
0444	0470	
0444	0470	T5: 'process up arrow key
0449	0470	IF MENUZ MOD 6 = 0 THEN RETURN: 'in top row already
045E	0470	DIFFZ = -1:GOSUB NEWMENU:RETURN: 'move pointer up one
046F	0472	
046F	0472	T6: 'process down arrow key
0474	0472	IF MENUZ MOD 6 = 5 THEN RETURN: 'in bottom row already
048A	0472	DIFFZ = 1:GOSUB NEWMENU:RETURN: 'move pointer down one
0498	0472	
0498	0472	T7: 'process left arrow key
04A0	0472	IF INT(MENUZ / 6) = 0 THEN RETURN: 'in left column already
04C0	0472	DIFFZ = -6:GOSUB NEWMENU:RETURN: 'move pointer one left
04D1	0472	
04D1	0472	T8: 'process right arrow key
04D6	0472	IF INT(MENUZ / 6) = 2 THEN RETURN: 'in right column already
04F9	0472	DIFFZ = 6:GOSUB NEWMENU:RETURN: 'move pointer one right
050A	0472	
050A	0472	T9: 'input keys into KEYBUF\$ until <cr> is entered
050F	0472	LOCATE 25,30:COLOR 31,0:PRINT "ENTER NEW VALUE";:COLOR 15,0
0541	0472	KEYBUF\$ = AS
054B	0476	WHILE AS <> CHR\$(13)
055E	0476	LOCATE 25,47:PRINT SPACES(20);
057B	0476	LOCATE 25,47:PRINT KEYBUF\$;
0595	0476	AS = ""
059F	0476	WHILE AS = ""
05AE	0476	AS = INKEY\$
05B8	0476	WEND
05B9	0476	IF AS = CHR\$(8) AND LEN(KEYBUF\$) > 0 THEN KEYBUF\$ = LEFT\$(KEYBUF\$,LEN(KEYBUF\$)-1)
05FD	0476	IF AS > CHR\$(13) THEN KEYBUF\$ = KEYBUF\$ + AS
061E	0476	WEND
0622	0476	TEMP = VAL(KEYBUF\$) 'temp has value of keys input
0632	047A	
0632	047A	'round off temp according to step size in menu array
0632	047A	TEMP = INT(TEMP / (MENU(MENUZ,3) + .5) + MENU(MENUZ,3)
0668	047A	
0668	047A	'test TEMP for maximum and minimum values in menu array
0668	047A	IF TEMP > MENU(MENUZ,1) THEN TEMP = MENU(MENUZ,1)
06A8	047B	IF TEMP < MENU(MENUZ,2) THEN TEMP = MENU(MENUZ,2)
06E9	047A	
06E9	047A	'insert new value into menu array and update screen
06E9	047A	MENU(MENUZ,0) = TEMP
0705	047A	LOCATE 25,30:PRINT SPACES(40);
0722	047A	COLOR 0,7:GOSUB DISPMENU
0734	047A	RETURN
0738	047A	
0738	047A	T2: 'set Burr-Brown board then print desired pattern
073D	047A	
073D	047A	BEEP:COLOR 15,0:LOCATE 25,1
075A	047A	PRINT "Set Potentiometers on Printer....then Press any Key";
0767	047A	AS = ""
0771	047A	WHILE AS = ""

5 Reagent Jet Printer  
Pattern Printing

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IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
	0780 047A	AS = INKEYS
10	078A 047A	WEND
	078D 047A	LOCATE 25,1:PRINT SPACES(79);
	07AA 047A	
	07AA 047A	'enter drcs parameters into burr-brown board
	07AA 047A	TEMP = MENU(0,0):CALL SET.DOT.RATE(TEMP)
	07D3 047A	TEMP = 5:CALL SET.DOT.WIDTH(TEMP)
15	07ED 047A	TEMP = MENU(2,0):CALL SET.STROBE.DELAY(TEMP)
	0819 047A	CALL DOT.ON
	0825 047A	
	0825 047A	TEMP1 = 4
	082C 047C	CALL DIGITAL.OUT(TEMP1)
20	083C 047C	TEMP1 = 0: 'pulse RESET line
	0843 047C	CALL DIGITAL.OUT(TEMP1)
	0853 047C	TEMP1 = 4
	085A 047C	CALL DIGITAL.OUT(TEMP1)
	086A 047C	
	086A 047C	J2 = CINT(MENU(1,0) * 255 / 150): 'set pulse amplitude by pulsing HIGHER signal J2 number of times
25	0893 047E	FOR I2 = 1 TO J2
	08A0 0480	TEMP1 = 6: 'set HIGHER true
	08A7 0480	CALL DIGITAL.OUT(TEMP1)
	08B7 0480	TEMP1 = 4: 'set HIGHER false
	08BE 0480	CALL DIGITAL.OUT(TEMP1)
	08CE 0480	NEXT I2
30	08E0 0482	
	08E0 0482	'establish COM1: and initialize plotter
	08E0 0482	OPEN "COM1:2400,N,8,2,CS 65535" AS #1
	08F2 0482	PRINT #1,":UECS,EPV1,M";
	0902 0482	
	0902 0482	'move nozzle offset and establish new origin
35	0902 0482	PRINT #1,"AG";
	0912 0482	
	0912 0482	'calculate row/column location, move there, and set new origin
	0912 0482	I2 = (MENU(12,0)-1) * (MENU(14,0) / 0.005)
	0954 0484	J2 = (MENU(13,0)-1) * (MENU(15,0) / 0.005)
	0996 0486	PRINT #1,I2;J2;"D";
40	09B4 0486	
	09B4 0486	'print the pattern using repeat count
	09B4 0486	REPLY2 = MENU(8,0) / 0.005
	09D7 0488	REPLY2 = MENU(9,0) / 0.005
	09FA 048A	
	09FA 048A	FOR REPEAT2 = 0 TO MENU(7,0)
45	0A1C 048C	
	0A1C 048C	'print the pattern
	0A1C 048C	FOR CT2 = 0 TO ELNMY2 - 1
	0A2A 0490	ON SCNEAT2(CT2,0) GOSUB PLINE, PRECT, PSRECT, PCIRCL
	0A4C 0492	NEXT CT2
	0A5E 0492	
50	0A5E 0492	PRINT #1,"A,0,0,"; 'return to origin
	0A6E 0492	PRINT #1,REPLY2;REPLY2;"D"; 'move to next pattern
	0A8C 0492	NEXT REPEAT2
	0AA1 0494	
	0AA1 0494	PRINT #1,"M"; 'return plotter to original HOME
55	0AB1 0494	

5 Reagent Jet Printer  
Pattern Printing

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IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
	0A51 0494	CLOSE #1: 'disable cool:
10	0A58 0494	RETURN
	0A59 0494	PLINE:
	0A5C 0494	PRINT #1,SENDATZ(CTZ,2);SENDATZ(CTZ,1);"0";
	0A61 0494	PRINT #1,SENDATZ(CTZ,4);SENDATZ(CTZ,3);"U";
15	0B03 0494	RETURN
	0B45 0494	FREET:
	0B49 0494	PRINT #1,SENDATZ(CTZ,2);SENDATZ(CTZ,1);"0";
	0B49 0494	PRINT #1,SENDATZ(CTZ,4);SENDATZ(CTZ,3);
	0B4E 0494	PRINT #1,SENDATZ(CTZ,4);SENDATZ(CTZ,3);
20	0BCC 0494	PRINT #1,SENDATZ(CTZ,2);SENDATZ(CTZ,3);
	0C08 0494	PRINT #1,SENDATZ(CTZ,2);SENDATZ(CTZ,1);"U";
	0C44 0494	RETURN
	0C86 0494	PCIRCL:
	0C8A 0494	RADIUSZ = SQR((SENDATZ(CTZ,3)-SENDATZ(CTZ,1)) <sup>2</sup> + (SENDATZ(CTZ,4)-SENDATZ(CTZ,2)) <sup>2</sup> )
25	0CBF 0494	PRINT #1,"CC ";SENDATZ(CTZ,2);SENDATZ(CTZ,1);RADIUSZ;
	0D1A 0496	RETURN
	0D63 0496	PSRECT:
	0D67 0496	SIZ = SENDATZ(CTZ,4);EIZ = SENDATZ(CTZ,2)
	0D6C 0496	SYZ = SENDATZ(CTZ,3);EYZ = SENDATZ(CTZ,1)
30	0DA0 049A	IF EIZ <= SIZ THEN SIZ = SENDATZ(CTZ,2);EIZ = SENDATZ(CTZ,4)
	0DD4 049E	IF EYZ <= SYZ THEN SYZ = SENDATZ(CTZ,1);EYZ = SENDATZ(CTZ,3)
	0E15 049E	PRINT #1,SIZ;SYZ;"0";
	0E56 049E	IF EIZ - SIZ >= EYZ - SYZ THEN GOSUB STEP1 ELSE GOSUB STEP1
35	0E74 049E	PRINT #1,"U";
	0E9D 049E	RETURN
	0EAD 049E	STEP1:
	0EB1 049E	PRINT #1,EIZ;SYZ;
40	0EB6 049E	SYZ = SYZ + 1
	0ECE 049E	IF SYZ > EYZ THEN RETURN
	0ED7 049E	PRINT #1,EIZ;SYZ;SIZ;SYZ;
	0EEB 049E	SYZ = SYZ + 1
	0F0E 049E	IF SYZ > EYZ THEN RETURN
45	0F17 049E	PRINT #1,SIZ;SYZ;
	0F28 049E	GOTO STEP1
	0F40 049E	STEP1:
	0F44 049E	PRINT #1,SIZ;EYZ;
	0F49 049E	SIZ = SIZ + 1
50	0F61 049E	IF SIZ > EIZ THEN RETURN
	0F6A 049E	PRINT #1,SIZ;EYZ;SIZ;SYZ;
	0F7B 049E	SIZ = SIZ + 1
	0FA1 049E	IF SIZ > EIZ THEN RETURN
	0FAA 049E	PRINT #1,SIZ;SYZ;
	0FBB 049E	GOTO STEP1
55	0FD3 049E	

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Pattern Printing

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IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
0F37	049E	
10 0F37	049E	NEWMENU: 'write old item in yellow, point to and highlight new item
0FDC	049E	COLOR 14,0:GOSUB DISPMENU
0FEE	049E	MENUZ = MENUZ + DIFFZ
0FFA	049E	IF MENUZ = 10 THEN MENUZ = 9
100C	049E	IF MENUZ = 11 THEN MENUZ = 9
101E	049E	IF MENUZ > 15 THEN MENUZ = 15
15 1030	049E	COLOR 0,7:GOSUB DISPMENU:RETURN
1046	049E	
1046	049E	INITIALIZE:
104B	049E	'change to screen 0 and display messages
104B	049E	SCREEN 0,0,1,1:COLOR 7,0:CLS:LOCATE 10,17:PRINT "Loading selected Reagent and Pattern Data Files";
108F	049E	LOCATE 12,33:PRINT "Please Wait..."
20 10A9	049E	
10A9	049E	'initialize notepad on screen 2
10A9	049E	SCREEN 0,0,2,1:CLS:COLOR 15
10CE	049E	PRINT "Digital Notepad - - All information typed here is sent to the printer"
10DB	049E	NOTELINE1 = 3
25 10E2	049E	
10E2	049E	'initialize menu arrays
10E2	049E	RESTORE ARRDATA
10E9	049E	FOR IX=0 TO 17
10EF	049E	READ MENU(IX,0),MENU(IX,1);
111F	049E	READ MENU(IX,1),MENU(IX,2),MENU(IX,3),MENU(IX,4)
30 1180	049E	NEXT IX
1193	049E	
1193	049E	'get default reagent file and read values
1193	049E	
11A4	049E	OPEN "REAGEF.RJP" FOR INPUT AS #1
11A4	049E	INPUT #1,FILES
35 11B6	04A2	INPUT #1,REAGNAMES
11CB	04A6	CLOSE #1
11CF	04A6	
11CF	04A6	OPEN FILES FOR INPUT AS #1: 'get reagent data
11E0	04A6	INPUT #1,MENU(0,0): 'frequency
1200	04A6	INPUT #1,MENU(1,0): 'amplitude
40 1223	04A6	INPUT #1,MENU(2,0): 'stroke delay
1246	04A6	INPUT #1,MENU(3,0): 'pulse width
1269	04A6	INPUT #1,MENU(4,0): 'rise time
128C	04A6	INPUT #1,MENU(5,0): 'fall time
12B1	04A6	CLOSE #1
12B8	04A6	
45 12B8	04A6	'get default pattern file and read values
12B8	04A6	
1298	04A6	OPEN "PATDEF.RJP" FOR INPUT AS #1
12C9	04A6	INPUT #1,FILES
12DB	04A6	INPUT #1,PATNAMES
12ED	04AA	CLOSE #1
50 12F4	04AA	
12F4	04AA	OPEN FILES FOR INPUT AS #1: 'get pattern data
1305	04AA	INPUT #1,ELNUTZ
1317	04AA	INPUT #1,MENU(6,0): 'grid
132A	04AA	INPUT #1,MENU(7,0): 'repeat count
1350	04AA	INPUT #1,MENU(8,0): 'x offset

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Pattern Printing

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IBM Personal Computer 8651C Cassette V2

Offset	Data	Source Line
	1360 04AA	INPUT #1,MENU(9,0): 'y offset
10	13A3 04AA	FOR IZ = 0 TO ELEMZ-1
	13B1 04AC	FOR JZ = 0 TO 5
	13B7 04AC	INPUT #1,SCNDATZ(IZ,JZ)
	13DB 04AC	NEXT JZ
	13EB 04AC	NEXT IZ
	13FD 04AC	CLOSE #1
15	1404 04AC	
	1404 04AC	'set remaining parameters in menu array
	1404 04AC	
	1404 04AC	MENU(12,0) = 1: 'row 1
	1420 04AC	MENU(13,0) = 1: 'column 1
	143C 04AC	MENU(14,0) = 0: 'row spacing
20	1458 04AC	MENU(15,0) = 0: 'column spacing
	1474 04AC	
	1474 04AC	'change active displayed screen to screen 0 to draw and display parameters
	1474 04AC	
	1474 04AC	SCREEN 0,0,0,1:CLS
25	1491 04AC	
	1491 04AC	COLOR 13:LOCATE 1,32:PRINT "REAGENT PRINTING";
	14B2 04AC	COLOR 9
	14B9 04AC	FOR I=2 TO 79
	14C3 04AC	LOCATE 3,1:PRINT CHR\$(196);LOCATE 5,1:PRINT CHR\$(205);LOCATE 18,1:PRINT CHR\$(196);
	1523 04B0	NEXT I
30	153E 04B0	FOR I=4 TO 17
	1548 04B0	LOCATE 1,1:PRINT CHR\$(179);LOCATE 1,28:PRINT CHR\$(186);LOCATE 1,54:PRINT CHR\$(186);LOCATE 1,5
	15C8 04B0	PRINT CHR\$(179);
	15E6 04B0	NEXT I
	15ED 04B0	RESTORE TABLE
	15F7 04B0	FOR I=1 TO 12
35	162A 04B6	READ RZ,CZ,NZ:LOCATE RZ,CZ:PRINT CHR\$(NZ);
	1645 04B6	NEXT I
	1645 04B6	'display 16 menu choices in yellow
	1645 04B6	
	1645 04B6	COLOR 14,0
40	1651 04B6	FOR MENUZ = 0 TO 15
	1657 04B6	GOSUB DISPMENU
	165D 04B6	NEXT MENUZ
	166D 04B6	
	166D 04B6	'set for first menu entry and highlight it
	166D 04B6	MENUZ = 0:COLOR 0,7
45	1680 04B6	GOSUB DISPMENU
	1686 04B6	
	1686 04B6	'print three headings and instructions
	1686 04B6	COLOR 10,0
	1692 04B6	LOCATE 4,14.5-LEN(REANAMES)/2:PRINT REANAMES;
	16C1 04B6	LOCATE 4,41-LEN(PATNAMES)/2:PRINT PATNAMES;
50	16F0 04B6	LOCATE 4,60:PRINT "PRINT LOCATION";
	170A 04B6	
	170A 04B6	COLOR 7:LOCATE 19,20:PRINT "Use ";:COLOR 15:PRINT CHR\$(27);CHR\$(32);CHR\$(26);
	1754 04B6	PRINT CHR\$(32);CHR\$(24);CHR\$(32);CHR\$(25);:COLOR 7:PRINT " to position highlighted cursor";
	1793 04B6	LOCATE 20,18:PRINT "Use ";:COLOR 15:PRINT " ";:COLOR 7:PRINT " or ";:COLOR 15:PRINT "-";
	17E9 04B6	COLOR 7:PRINT " to scroll current value up or down";

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Reagent Jet Printer  
Pattern Printing

PAGE  
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08:49:

Offset Data Source Line

IBM Personal Computer BASIC Compiler V2.

```

25 17FD 0486 LOCATE 21,5:PRINT "Use ";:COLOR 15:PRINT "P";:COLOR 7:PRINT " to print pattern or ";
    183F 0486 COLOR 15:PRINT "E";:COLOR 7:PRINT " to exit to print menu";
    1867 0486 PRINT " or ";:COLOR 15:PRINT "S";:COLOR 7:PRINT " to use notepad";
    189C 0486
    189C 0486 'set screen to view menu just created and exit
    189C 0486
30 189C 0486 SCREEN 0,0,0,0
    18B1 0486 RETURN
    18B5 0486
    18B5 0486 DISPMENU:
    18BA 0486 IF MENUZ = 10 OR MENUZ = 11 THEN RETURN
    18CE 0486 LOCATE (MENUZ MOD 6)+2+7,(INT(MENUZ/6)+28+2)-2+INT(MENUZ/12)
35 193B 0486 PRINT MENU$(MENUZ,0)
    1956 0486 LOCATE (MENUZ MOD 6)+2+7,MENU(MENUZ,4)
    1959 0486 PRINT USING MENU$(MENUZ,1);MENU(MENUZ,0);
    195B 0486 RETURN
    197F 0486 REM SPAGE

```

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Request: Jet Printer  
 70 Pattern Printing

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 08:45

IBM Personal Computer BASIC Compiler V2

Offset	Data	Source Line
19BF	04B6	***** DATA USED BY THIS MODULE *****
19BF	04B6	
15	19BF	ASRDATA:
19C4	04B6	DATA *Dot Frequency Hz,"00,000",10000.1,1,16
19C6	04B6	DATA *Amplitude V,"000",150.0,1,19
19CB	04B6	DATA *Stroke Delay uS,"00,000.0",15999.5,.5..5,16
19CA	04B6	DATA *Pulse Width ", "000",999,0,1,19
19CC	04B6	DATA *Rise Time ", "000",999,0,1,19
20	19CE	DATA *Fall Time ", "000",999,0,1,19
19D0	04B6	DATA *Grid Size in","0.000",.005..005..005,45
19D2	04B6	DATA *Repeat Count ", "00",99,0,1,47
19D4	04B6	DATA *X Axis Offset in","0.000",2,0..005,45
19D6	04B6	DATA *Y Axis Offset in","0.000",2,0..005,45
19D8	04B6	DATA **,",",0,0,0,0
25	19DA	DATA **,",",0,0,0,0
19DC	04B6	DATA *Row to Print ", "00",99,1,1,74
19DE	04B6	DATA *Column to Print ", "00",99,1,1,74
19E0	04B6	DATA *Row Spacing in","0.000",3,0..005,72
19E2	04B6	DATA *Column Spacing in","0.000",3,0..005,72
30	19E4	DATA **,",",0,0,0,0
19E6	04B6	DATA **,",",0,0,0,0
19E8	04B6	
19EB	04B6	TABLE:
19ED	04B6	DATA 3,1,218
19EF	04B6	DATA 3,28,210
35	19F1	DATA 3,54,210
19F3	04B6	DATA 3,80,191
19F5	04B6	DATA 5,1,198
19F7	04B6	DATA 5,28,206
19F9	04B6	DATA 5,54,206
19FB	04B6	DATA 5,80,181
40	19FD	DATA 18,1,192
19FF	04B6	DATA 18,28,208
1A01	04B6	DATA 18,54,208
1A03	04B6	DATA 18,80,217
1A05	04B6	
1A05	04B6	END SUB
45	1A0C	04B6
1A0C	04B6	
2069	04B6	

50426 Bytes Available  
 44716 Bytes Free

50  
 0 Warning Error(s)  
 0 Severe Error(s)

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Reagent Jet Printer  
Reagent Filing

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Offset: Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0030 0006 REM $TITLE: 'Reagent Jet Printer' $SUBTITLE: 'Reagent Filing'
      0030 0006 MODULE - 'RE4FILE' File Handling for reagents
      0030 0006
10     0030 0006 AUTHOR - N. A. Enevold
      0030 0006
      0030 0006 COPYRIGHT (C) 1985 ABBOTT LABORATORIES
      0030 0006
      0030 0006 REVISION - 1.1 03-07-86 NAE Added notes and description
      0030 0006 1.0 02-14-86 NAE Creation of initial code
15     0030 0006
      0030 0006 SYSTEM - This code can only be compiled by the BASCOM
      0030 0006 COMPILE, it will not run under the INTERPRETER!!
      0030 0006
20     0030 0006 DESCRIPTION:
      0030 0006 This module allow file handling for reagents. When inv
      0030 0006 oked, it displays
      0030 0006 the current contents of the reagent directory in 4 colu
      0030 0006 ans of 20 entries
25     0030 0006 each. The reagent which is currently selected for prin
      0030 0006 ting is marked by
      0030 0006 an asterisk to the left of the reagent name. After the
      0030 0006 directory is listed
      0030 0006 the user is presented with 5 menu choices. The left an
30     0030 0006 d right arrows are
      0030 0006 used to highlight menu items and the enter key is used
      0030 0006 to invoke action.
      0030 0006 The menu choices and their actions are:
35     0030 0006
      0030 0006 DELETE - Remove a reagent file from the directo
      0030 0006 ry
      0030 0006 COPY - Copy a reagent file to a new reagent n
      0030 0006 ame, saving the old reagent
      0030 0006 RENAME - Change the name of the reagent without
40     0030 0006 changing the reagent itself
      0030 0006 SELECT - Select a reagent for printing
      0030 0006 EXIT - Return to the main menu
      0030 0006
      0030 0006 DATA DICTIONARY
      0030 0006
45     0030 0006 TYPEZ Which type of valid key was pushed
      0030 0006 MENUZ Which menu item is being pointer to (0-4)
      0030 0006 DIFFZ Distance to move MENUZ at left or right arro
      0030 0006
      0030 0006
      0030 0006 FLAGZ Error type 0-4
      0030 0006 POINTERZ Position of REANAMES in directory list
50     0030 0006 REANUMZ Number of reagent names in directory
      0030 0006 list
      0030 0006
      0030 0006 TEMPI Storage for integers during reagent copy
      0030 0006 AS Misc. input string
      0030 0006 FUNCTS Printed at bottom of screen during prompt fo
55     0030 0006 r reagent name
      0030 0006 REANAMES Reagent name currently being worked on
      0030 0006 SELNAMES Reagent name currently selected for printing
      0030 0006 FILES Filename of reagent data file
      0030 0006 SFILES Filename for source reagent data file used d

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13104103
Offset  Data      Source Line
IBM Personal Computer BASIC Compiler V2.00

```

```

0030 0006   .   CPFILES      Filename for destination reagent data file u
                                sed during copy
0030 0006   .   NEWNAMES    New reagent name for COPY and RENAME
0030 0006   .   TEMPS      Reagent names are held here as the directory
                                is being re-written
0030 0006   .   NEWFILES    Destination filename used while copying reag
                                ent data files
0030 0006   .   MESSAGES    A message printed at the bottom of the screen
                                n
0030 0006   .   MENUS(4,1)  Array of strings containing the short and long menu
                                names
0030 0006   .   ERRMSG$     Message printed when any error occurs
0030 0006   .   ERR$       Appended to ERRMSG$ to indicate nature of error
                                for
0030 0006   REM SPACE

```

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Offset  Data      Source Line      IBM Personal Computer BASIC Compiler V2.00

```

```

0030      0000      SUB REPEAT.FILE STATIC
0047      0006
0047      0006      GOSUB INITIALIZE
004D      0006      TYPEZ = 0
0054      0008
0054      0008      WHILE TYPEZ <> 3
005F      0008      AS = ""
0069      000C      WHILE AS = ""
0078      000C      AS = INKEY$
0082      000C      WEND
0085      000C      IF AS = CHR$(10) + CHR$(75) THEN TYPEZ = 1:
'left arrow
00AA      000C      IF AS = CHR$(10) + CHR$(77) THEN TYPEZ = 2:
'right arrow
00CF      000C      IF AS = CHR$(13) THEN TYPEZ = 3:
'<cr> to execute selection
00E9      000C
00E9      000C      ON TYPEZ GOSUB T1, T2, T3
00FB      000C      WEND
00FC      000C
00FC      000C      EXIT SUB
0100      000C
0100      000C      REM SPACE

```

```

00E9 000C
00E9 000C
00FB 000C
00FC 000C
00FC 000C
0100 000C
0100 000C

```

0100 0000 REM SPACE

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Reagent Jet Printer  
Reagent Filling

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20	Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
	0100	000C	***** SUB-ROUTINES FOR THIS MODULE *****	
	0100	000C		
	0100	000C	T1:           Left arrow	
25	0105	000C	TYPE1 = 0	
	010C	000C	IF MENU1 = 0 THEN RETURN	
	0118	000E	DIFF1 = -1	
	0122	0010	GOSUB NEW.MENU	
	0128	0010	RETURN	
30	012C	0010		
	012C	0010	T2:           Right arrow	
	0131	0010	TYPE1 = 0	
	0138	0010	IF MENU1 = 1 THEN RETURN	
	0147	0010	DIFF1 = 1	
35	014E	0010	GOSUB NEW.MENU	
	0154	0010	RETURN	
	0158	0010		
	0153	0010	T3:           (cr) (execute selected menu item)	
	015D	0010	LOCATE 25,1:PRINT SPACES(79);	
40	017A	0010	ON MENU1 + 1 GOSUB T0A, T0B, T0C, T0D, T0E	
	018F	0010	GOSUB MENU.ON	
	0195	0010	RETURN	
	0199	0010		
	0199	0010	REN 4PAGE	

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Reagent Jet Printer  
Reagent Filing

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
5	0199 0010	T3A: 'delete reagent
	019E 0010	TYPEZ = 0
	01A5 0010	FUNCT\$ = "Delete"
	01AF 0014	GOSUB GET.SOURCE
10	01B5 0014	IF LEN(REANAME\$) = 0 THEN RETURN
	01C7 0018	IF REANAME\$ = SELNAME\$ THEN FLAGZ = 4:GOSUB SHOW.ERROR:
		RETURN
	01E7 001E	GOSUB SEARCH
	01ED 001E	IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
15	0209 0020	MESSAGE\$ = "Deleting " + REANAME\$ + " Please Wait..
	0209 0020	
	0220 0024	GOSUB MESSAGE.ON
	0226 0024	
20	0226 0024	'rewrite directory deleting REANAME\$ as indicat
		ed by POINTERZ
	0226 0024	KILL "READIR.OLD"
	022D 0024	NAME "READIR.RJP" AS "READIR.OLD"
	0237 0024	OPEN "READIR.OLD" FOR INPUT AS #1
25	0248 0024	OPEN "READIR.RJP" FOR OUTPUT AS #2
	025A 0024	
	025A 0024	INPUT #1, REANUMZ
	026C 0026	REANUMZ = REANUMZ - 1
	0275 0026	WRITE #2,REANUMZ
30	0286 0026	
	0286 0026	IF REANUMZ = 0 THEN GOTO DIR.DONE
	0295 0026	FOR IZ = 1 TO REANUMZ + 1
	02A4 0028	INPUT #1,REANAME\$
	02B6 0028	IF IZ (<) POINTERZ THEN PRINT #2,REANAME\$
35	02D3 002A	NEXT IZ
	02E5 002A	
	02E5 002A	DIR.DONE:
	02EA 002A	CLOSE #1:CLOSE #2
	02FB 002A	
40	02FB 002A	'remove data file
	02FB 002A	FILES\$ = RIGHT\$(STR\$(POINTERZ),LEN(STR\$(POINTERZ))-1) +
		"REA.RJP"
	031C 002E	KILL FILES
	0323 002E	
45	0323 002E	'rename remaining data files to maintain linked
		list to directory
	0323 002E	WHILE (REANUMZ + 1) > POINTERZ
	0333 002E	SFILES\$ = RIGHT\$(STR\$(POINTERZ+1),LEN(STR\$(POINT
		ERZ+1))-1) + "REA.RJP"
	0359 0032	DFILES\$ = RIGHT\$(STR\$(POINTERZ),LEN(STR\$(POINTER
50		Z))-1) + "REA.RJP"
	037D 0036	NAME SFILES\$ AS DFILES\$
	0387 0036	POINTERZ = POINTERZ + 1
	0390 0036	WEND
55	0393 0036	GOSUB MESSAGE.OFF
	0393 0036	REANAME\$ = SELNAME\$
	0399 0036	GOSUB T3DA
	03A3 0036	GOSUB DISP.DIR
	03A9 0036	

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Reagent Jet Printer  
Reagent Filing

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Offset Data Source Line

IBM Personal Computer BASIC Compiler V2.00

03AF 0036 RETURN  
03B3 0036  
03B3 0036 REM SPAGE

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Reagent Jet Printer  
Reagent Filing

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0383 0036 132: 'copy reagent
      0388 0036      TYPE1 = 0
      038F 0036      IF REANUMZ = 60 THEN FLAGZ = 3:GOSUB SHOW.ERROR:RETURN
      03DB 0036      FUNCTS = "Copy"
10     03E5 0036      GOSUB GET.SOURCE
      03EB 0036      IF LEN(REANAMES) = 0 THEN RETURN
      03FD 0036      GOSUB SEARCH
      0403 0036      IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
      041F 0036
15     041F 0036      GOSUB GET.NEW.NAME
      0425 0036      IF LEN(NEWNAME$) = 0 THEN RETURN
      0437 003A      IF LEN(NEWNAME$) > 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
      ETURN

      0457 003A
20     0457 003A      MESSAGE$ = "Copying " + REANAMES + " to " + NEWNAME$ +
      " Please wait..."
      047C 003A      GOSUB MESSAGE.ON
      0482 003A
      0482 003A      'add new name at end of directory
25     0482 003A      KILL "READIR.OLD"
      0489 003A      NAME "READIR.RJP" AS "READIR.OLD"
      0493 003A      OPEN "READIR.OLD" FOR INPUT AS #1
      04A4 003A      OPEN "READIR.RJP" FOR OUTPUT AS #2
      04B6 003A
30     04B6 003A      INPUT #1, REANUMZ
      04CB 003A      REANUMZ = REANUMZ + 1
      04D1 003A      WRITE #2, REANUMZ
      04E2 003A
      04E2 003A      FOR IZ = 1 TO REANUMZ - 1
35     04F1 003C          INPUT #1, TEMP$
      0503 0040          PRINT #2, TEMP$
      0513 0040      NEXT IZ
      0525 0040      PRINT #2, NEWNAME$
      0535 0040
40     0535 0040      CLOSE #1:CLOSE #2
      0543 0040
      0543 0040      'create copy of data file
      0543 0040      FILES = RIGHT$(STR$(POINTERZ), LEN(STR$(POINTERZ))-1) +
      "REA.RJP"
45     0567 0040      NEWFILES = RIGHT$(STR$(REANUMZ), LEN(STR$(REANUMZ))-1) +
      "REA.RJP"
      058B 0044
      058B 0044      OPEN FILES FOR INPUT AS #1
      059C 0044      OPEN NEWFILES FOR OUTPUT AS #2
50     05AE 0044
      05AE 0044      INPUT #1, TEMP
      05C0 0048      WRITE #2, TEMP: "frequency"
      05D0 0048      INPUT #1, TEMP
      05E2 0048      WRITE #2, TEMP: "pulse width"
55     05F2 0048      INPUT #1, TEMP
      0604 0048      WRITE #2, TEMP: "strobe delay"
      0614 0048      INPUT #1, TEMP
      0626 0048      WRITE #2, TEMP: "nozzle"
      0636 0048

```



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Reagent Jet Printer  
Reagent Filing

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

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0636	0048	INPUT #1,TEMPs	
0648	0048	PRINT #2,TEMPs:	'concentration
0658	0048	INPUT #1,TEMPs	
066A	0048	PRINT #2,TEMPs:	'density
067A	0048	INPUT #1,TEMPs	
068C	0048	PRINT #2,TEMPs:	'viscosity
067C	0048		
069C	0048	CLOSE #1:CLOSE #2	
06AA	0048		
06AA	0048	GOSUB MESSAGE.OFF	
06B0	0048	GOSUB DISP.DIR	
06B6	0048	RETURN	
06BA	0048		
06BA	0048	REM #PAGE	

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Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
06BA	0046	700:	'rename reagent
06BF	0043		TYPEZ = 0
06C6	0048		FUNCT\$ = "Rename"
06D0	0048		GOSUB GET.SOURCE
06D6	0048		IF LEN(REANAME\$) = 0 THEN RETURN
06E3	0048		GOSUB SEARCH
06EE	0048		IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
070A	0048		GOSUB GET.NEW.NAME
070A	0048		IF LEN(NEWNAME\$) = 0 THEN RETURN
0710	0048		IF LEN(NEWNAME\$) > 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
0722	0048		RETURN
0742	0048		IF NEWNAME\$ = REANAME\$ THEN RETURN
0755	0048		MESSAGE\$ = "Renaming " + REANAME\$ + " to " + NEWNAME\$ + " Please wait..."
077A	0046		GOSUB MESSAGE.ON
0780	0048		
0790	0048		'renaming reagent name in directory
0780	0048		KILL "READIR.OLD"
0787	0048		NAME "READIR.RJP" AS "READIR.OLD"
0791	0048		OPEN "READIR.OLD" FOR INPUT AS #1
07A2	0048		OPEN "READIR.RJP" FOR OUTPUT AS #2
07B4	0048		
07B4	0048		INPUT #1, REANUMZ
07C6	0048		WRITE #2,REANUMZ
07D7	0048		
07D7	0048		FOR IZ = 1 TO REANUMZ
07E4	004A		INPUT #1,TEMP\$
07F6	004A		IF IZ <> POINTERZ THEN PRINT #2,TEMP\$
0813	004A		IF IZ = POINTERZ THEN PRINT #2,NEWNAME\$
0830	004A		NEXT IZ
0842	004A		
0842	004A		CLOSE #1:CLOSE #2
0850	004A		
0850	004A		GOSUB MESSAGE.OFF
0856	004A		IF REANAME\$ = SELNAME\$ THEN REANAME\$ = NEWNAME\$:GOSUB T
		JDA	
0875	004A		GOSUB DISP.DIR
087B	004A		RETURN
087F	004A		
087F	004A		REM SPAGE

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Offset: Data Source Line IEN Personal Computer BASIC Compiler V2.00

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```
067F 004A TJS: 'select reagent for printing
0684 004A 'TYPE1 = 0
0689 004A FUNCTS = 'Select'
0695 004A GOSUB GET.SOURCE
069B 004A IF LEN(REALNAMES) = 0 THEN RETURN
08A0 004A IF REALNAMES = SELNAMES THEN RETURN
06C0 004A GOSUB TJSB
06C6 004A GOSUB DISP.DIR
06CC 004A RETURN
```

25

```
08D0 004A TJSB:
08D5 004A GOSUB SEARCH
08D6 004A IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
08F7 004A MESSAGE$ = 'Selecting ' + REALNAMES + ' Please Wait.
08F7 004A ..
090E 004A GOSUB MESSAGE.ON
```

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```
0914 004A
0914 004A JP 'change entries in reagent default file READEF.R
0914 004A
0926 004A OPEN 'READEF.RJP' FOR OUTPUT AS #1
FILES = RIGHT$(STR$(POINTERZ), LEN(STR$(POINTERZ))-1) +
'REA.RJP'
```

40

```
094A 004A PRINT #1,FILES
094A 004A PRINT #1,REALNAMES
095A 004A
096A 004A CLOSE #1
0971 004A GOSUB MESSAGE.OFF
0977 004A RETURN
```

45

```
097B 004A TJS:
097B 004A 'exit reagent filing
0980 004A RETURN
```

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```
0984 004A REN SPACE
```

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Reagent Jet Printer  
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```

Offset  Data  Source Line  IBM Personal Computer BASIC Compiler V2.00

5      0984  004A  SEARCH:
      0987  004A          POINTERZ = 0
      0990  004A          OPEN "READIR.RJP" FOR INPUT AS #1
      09A1  004A          INPUT #1,REANUMZ: 'get number of reagents in direc
10      09B3  004A          tory
      09C9  004A          IF REANUMZ = 0 THEN CLOSE #1:RETURN
      09D3  004A          TEMPZ = ""
      09D3  004A          WHILE (POINTERZ < REANUMZ) AND (REANAMES <> TEMPZ)
      09FE  004A              LINE INPUT #1,TEMPZ
      0A06  004A              POINTERZ = POINTERZ + 1
15      0A11  004A          WEND
      0A14  004A          IF REANAMES <> TEMPZ THEN POINTERZ = 0
      0A2A  004A          CLOSE #1
      0A31  004A          RETURN
20      0A35  004A  GET.SOURCE:
      0A3A  004A          LOCATE 25,1:COLOR 15,0:PRINT "Enter Reagent Name to 'FU
      0A6C  004A          NCTS" ";
      0A7A  004A          LINE INPUT;"",REANAMES
      0A77  004A          LOCATE 25,1:PRINT SPACES(79);
      0A9B  004A          RETURN
      0A9B  004A  GET.NEW.NAME:
      0AA0  004A          LOCATE 25,1:COLOR 15,0:PRINT "Enter New Reagent Name ";
      0AC6  004A          LINE INPUT;"",NEWNAME$
      0AD4  004A          LOCATE 25,1:PRINT SPACES(79);
      0AF1  004A          RETURN
      0AF5  004A  DISP.DIR: 'display reagent directory in 4 columns of 20 r
      0AF5  004A          cos
35      0AFA  004A          'read selected reagent into SELNAME$
      0AFA  004A          OPEN "READEP.RJP" FOR INPUT AS #1
      0B08  004A          INPUT #1,SELNAME$: 'read and discard data file nam
      0B1D  004A          INPUT #1,SELNAME$: 'read and save reagent name
40      0B2F  004A          CLOSE #1
      0B36  004A          OPEN "READIR.RJP" FOR INPUT AS #1
      0B36  004A          INPUT #1,REANUMZ: 'read number of reagents
      0B47  004A          MESSAGE$ = "Reading Reagent Directory Please Wait"
45      0B57  004A          GOSUB MESSAGE.OM
      0B63  004A          FLAGZ = 0
      0B69  004A          TEMPZ = REANUMZ - 1:IF REANUMZ < 80 THEN TEMPZ = REANUM
      0B70  004A          1
50      0B88  004C          FOR IZ = 0 TO TEMPZ
      0B97  004E              LOCATE (IZ MOD 20)+1,(INT(IZ/20)+20)+1
      0BCA  004E              PRINT SPACES(18);
      0BDA  004E          NEXT IZ
      0BEC  004E          FOR IZ = 0 TO REANUMZ - 1
55      0BEC  004E              INPUT #1,REANAMES
      0BFA  0050              LOCATE (IZ MOD 20)+1,(INT(IZ/20)+20)+3
      0C0C  0050              PRINT REANAMES:
      0C3F  0050              IF REANAMES = SELNAME$ THEN LOCATE (IZ MOD 20)+
      0C4C  0050

```

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Offset Data Source Line

IBM Personal Computer BASIC Compiler V2.00

```

5      1, (INT((20/20)*20)+1):PRINT "+";
      0C9E 0C50      NEXT I2
      0CB0 0C50      CLOSE #1
      0CB7 0C50      GOSUB MESSAGE.OFF
10     0CB0 0C50      RETURN
      0CC1 0C50
      0CC1 0C50      INITIALIZE:
      0CC6 0C50      DIM MENU$(4,1)
      0CC7 0C78      MENU$(0,0) = "Delete"
15     0CDF 0C78      MENU$(0,1) = "Remove a reagent file from the directory"
      0CF8 0C78      MENU$(1,0) = "Copy"
      0D15 0C78      MENU$(1,1) = "Copy a reagent file to a new reagent name"

      0D2E 0C78      MENU$(2,0) = "Rename"
20     0D48 0C78      MENU$(2,1) = "Rename a reagent file in the directory"
      0D69 0C78      MENU$(3,0) = "Select"
      0D84 0C78      MENU$(3,1) = "Select a reagent file to be printed"
      0DA0 0C78      MENU$(4,0) = "Exit"
      0DB8 0C78      MENU$(4,1) = "Return to the main menu"
25     0DD7 0C78
      0DD7 0C78      COLOR 9,0:CLS
      0DEA 0C78      LOCATE 21,1
      0DF7 0C78      FOR I2 = 1 TO 80
      0DFE 0C78          PRINT " ";
30     0E0B 0C78      NEXT I2
      0E1B 0C78
      0E1B 0C78      FOR MENU2 = 0 TO 4
      0E21 0C78          GOSUB MENU.OFF
35     0E27 0C78      NEXT MENU2
      0E37 0C78
      0E37 0C78      GOSUB DISP.DIR
      0E3D 0C78      IF FLAG2 > 0 THEN GOSUB SHOW.ERROR
      0E4E 0C78      MENU2 = 4
      0E55 0C78      GOSUB MENU.ON
40     0E5B 0C78
      0E5B 0C78      RETURN
      0E5F 0C78
      0E5F 0C78      NEW.MENU:
      0E64 0C78          GOSUB MENU.OFF
45     0E6A 0C78          MENU2 = MENU2 + DIFF2
      0E76 0C78          GOSUB MENU.ON
      0E7C 0C78          RETURN
      0E80 0C78
      0E80 0C78      MENU.ON:
50     0E85 0C78          LOCATE 22, (MENU2*10)+16
      0E9C 0C78          COLOR 0,7
      0EAB 0C78          PRINT MENU$(MENU2,0);
      0EC6 0C78          LOCATE 25, 40-LEN(MENU$(MENU2,1))/2
      0EFA 0C78          COLOR 7,0
55     0F06 0C78          PRINT MENU$(MENU2,1);
      0F25 0C78          RETURN
      0F29 0C78
      0F29 0C78      MENU.OFF:
      0F2E 0C78          LOCATE 22, (MENU2*10)+16

```

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```

5      Offset Data      Source Line
      0F45 0078      COLOR 14,0
      0F51 0078      PRINT MENU$(MENUZ,0);
      0F6F 0078      LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
      0FA3 0078      PRINT SPACES(LEN(MENU$(MENUZ,1)));
10     0FCB 0078      RETURN
      0FCC 0078
      0FCC 007E      SHOW.ERROR:
      0FD1 0078      ON FLAG% GOSUB ER1, ER2, ER3, ER4
      0FE2 0078      ERRMSG$ = ERR$ + " Strike any key.."
15     0FF2 0080      LOCATE 24,40-LEN(ERRMSG$)/2
      1014 0080      COLOR 13,0
      1020 0080      PRINT ERRMSG$;
      102D 0080      A$ = ""
      1037 0080      WHILE A$ = ""
20     1046 0080          A$ = INKEY$
      1050 0080      WEND
      1053 0080      GOSUB MESSAGE.OFF
      1059 0080      RETURN
      105D 0080
25     105D 0080      ER1:
      1062 0080          ERR$ = REANAMES + " Not Found in the Directory"
      1072 0080          RETURN
      1076 0080
      1076 0080      ER2:
30     1078 0080          ERR$ = "Reagent Name is too Long (15 characters max.)"
      1085 0080          RETURN
      1089 0080
      1089 0080      ER3:
      108E 0080          ERR$ = "Directory is Full (80 reagents max.)"
35     1098 0080          RETURN
      109C 0080
      109C 0080      ER4:
      10A1 0080          ERR$ = "Cannot Modify SELECTd reagent Name"
      10AB 0080          RETURN
40     10AF 0080
      10AF 0080      MESSAGE.ON:
      10B4 0080          LOCATE 24,38 - LEN(MESSAGE$) / 2:COLOR 11,0:PRINT MESSA
      10EF 0080          GE$;
      10EF 0080          RETURN
45     10F3 0080
      10F3 0080
      10F3 0080      MESSAGE.OFF:
      10FB 0080          LOCATE 24,1:COLOR 15,0:PRINT SPACES(79);
      1121 0080          RETURN
50     1125 0080
      1125 0080      END SUB
      112C 0080
      16C9 0080

```

50426 Bytes Available  
45718 Bytes Free

0 Warning Error(s)  
0 Severe Error(s)

Reagent Jet Printer  
Pattern Filing

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IBM Personal Computer BASIC Compiler V2.00

	Offset	Data	Source Line
5	0030	0006	REM TITLE: 'Reagent Jet Printer' \$SUBTITLE: 'Pattern Filing'
	0030	0006	MODULE - 'PATFILE' File Handling for patterns
	0030	0006	.
	0030	0006	AUTHOR - M. A. Enevold
10	0030	0006	.
	0030	0006	COPYRIGHT (C) 1985 ABBOTT LABORATORIES
	0030	0006	.
	0030	0006	REVISION - 1.0 02-12-86 NAE Creation of initial code
	0030	0006	.
15	0030	0006	SYSTEM - This code can only be compiled by the BASCOM
	0030	0006	COMPILER, it will not run under the INTERPRETER!!
	0030	0006	.
	0030	0006	DESCRIPTION:
	0030	0006	This module allow file handling for patterns. When invoked, it displays
20	0030	0006	the current contents of the pattern directory in 4 columns of 20 entries
	0030	0006	each. The pattern which is currently selected for printing is marked by
25	0030	0006	an asterisk to the left of the pattern name. After the directory is listed
	0030	0006	the user is presented with 5 menu choices. The left and right arrows are
	0030	0006	used to highlight menu items and the enter key is used to invoke action.
30	0030	0006	The menu choices and their actions are:
	0030	0006	.
	0030	0006	DELETE - Remove a pattern file from the directory
35	0030	0006	COPY - Copy a pattern file to a new pattern name, saving the old pattern
	0030	0006	RENAME - Change the name of the pattern without changing the pattern itself
	0030	0006	SELECT - Select a pattern for printing
40	0030	0006	EXIT - Return to the main menu
	0030	0006	.
	0030	0006	DATA DICTIONARY
	0030	0006	TYPEZ Which type of valid key was pushed
	0030	0006	MENUZ Which menu item is being pointer to (0-4)
45	0030	0006	DIFFZ Distance to move MENUZ at left or right arrow
	0030	0006	.
	0030	0006	FLAGZ Error type 0-4
	0030	0006	POINTERZ Position of PATNAMEZ in directory list
	0030	0006	PATNUMZ Number of pattern names in directory
50	0030	0006	list
	0030	0006	ELNUMZ Number of elements in a pattern file
	0030	0006	TEMPZ Storage for integers during pattern copy
	0030	0006	IZ Counter used during pattern copy
	0030	0006	JZ Counter used during pattern copy
55	0030	0006	AS Misc. input string
	0030	0006	FUNCTZ Printed at bottom of screen during prompt for pattern name
	0030	0006	PATNAMEZ Pattern name currently being worked on
	0030	0006	SELNAMEZ Pattern name currently selected for printing

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Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
0030	0006	FILES	Filename of pattern data file
0030	0006	SFILES	Filename for source pattern data file used during copy
0030	0006	DFILES	Filename for destination pattern data file used during copy
0030	0006	NEWNAMES	New pattern name for COPY and RENAME
0030	0006	TEMPS	Pattern names are held here as the directory is being re-written
0030	0006	NEWFILES	Destination filename used while copying pattern data files
0030	0006	MESSAGES	A message printed at the bottom of the screen
0030	0006	MENUS(4,1)	Array of strings containing the short and long menu names
0030	0006	ERRMSG\$	Message printed when any error occurs
0030	0006	ERR\$	Appended to ERRMSG\$ to indicate nature of error
0030	0006	TEMP	Storage of real variables while copying pattern data files
0030	0006	REM \$PAGE	

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Offset	Data	Source Line	IBM Personal Computer BASIC Compiler V2.00
0030	0006	SUB PATTERN.FILE STATIC	
0047	0006	GOSUB INITIALIZE	
0040	0006	TYPEZ = 0	
0054	0008	WHILE TYPEZ < 3	
0054	0008	AS = ""	
005F	0008	WHILE AS = ""	
0069	000C	AS = INKEY\$	
0076	000C	WEND	
0082	000C	IF AS = CHR\$(0) + CHR\$(75) THEN TYPEZ = 1:	
0085	000C	IF AS = CHR\$(0) + CHR\$(77) THEN TYPEZ = 2:	
00AA	000C	IF AS = CHR\$(13) THEN TYPEZ = 3:	
00CF	000C	IF AS = CHR\$(13) THEN TYPEZ = 3:	
00E9	000C	ON TYPEZ GOSUB T1, T2, T3	
00F6	000C	WEND	
00FC	000C	EXIT SUB	
0100	000C	REM \$PAGE	



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20

Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

25

0100 000C \*\*\*\*\* SUB-ROUTINES FOR THIS MODULE \*\*\*\*\*

0100 000C

0100 000C T1: 'left arrow

0105 000C TYPEZ = 0

010C 000C IF MENUZ = 0 THEN RETURN

0118 000E DIFFZ = -1

0122 0010 GOSUB NEW.MENU

0128 0010 RETURN

30

012C 0010

012C 0010 T2: 'right arrow

0131 0010 TYPEZ = 0

0138 0010 IF MENUZ = 4 THEN RETURN

0147 0010 DIFFZ = 1

35

014E 0010 GOSUB NEW.MENU

0154 0010 RETURN

0158 0010

0158 0010 T3: '<cr> (execute selected menu item)

015D 0010 LOCATE 25,1:PRINT SPACES(79);

40

017A 0010 ON MENUZ + 1 GOSUB T3A, T3B, T3C, T3D, T3E

018F 0010 GOSUB MENU.ON

0195 0010 RETURN

0199 0010

0199 0010 REM \$PAGE

45

50

55

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Offset	Data	Source Line
5	0197 0010	T3A: delete pattern
	019E 0010	TYPE3 = 0
	01A5 0010	FUNCTIONS = "Delete"
	01AF 0014	GOSUB GET.SOURCE
10	01B5 0014	IF LEN(PATNAME) = 0 THEN RETURN
	01C7 0016	IF PATNAME = SELNAME THEN FLAG% = 4:GOSUB SHOW.ERROR:
		RETURN
	01E7 001E	GOSUB SEARCH
	01ED 001E	IF POINTERR% = 0 THEN FLAG% = 1:GOSUB SHOW.ERROR:RETURN
15	0209 0020	MESSAGES = "Deleting " + PATNAME + " Please Wait..
	0209 0020	
	0220 0024	GOSUB MESSAGE.ON
	0226 0024	
20	0226 0024	'rewrite directory deleting PATNAME as indicat
		ed by POINTERR%
	0226 0024	KILL "PATDIR.OLD"
	022D 0024	NAME "PATDIR.RJP" AS "PATDIR.OLD"
	0237 0024	OPEN "PATDIR.OLD" FOR INPUT AS #1
25	0248 0024	OPEN "PATDIR.RJP" FOR OUTPUT AS #2
	025A 0024	
	025A 0024	INPUT #1, PATNUM%
	026C 0026	PATNUM% = PATNUM% - 1
	0275 0026	WRITE #2,PATNUM%
30	0286 0026	
	0286 0026	IF PATNUM% = 0 THEN GOTO DIR.DONE
	0295 0026	FOR I% = 1 TO PATNUM% + 1
	02A4 0028	INPUT #1,PATNAME%
	02B6 0028	IF I% < POINTERR% THEN PRINT #2,PATNAME%
35	02B5 002A	NEXT I%
	02E5 002A	DIR.DONE:
	02E5 002A	CLOSE #1:CLOSE #2
	02EA 002A	
	02FB 002A	'remove data file
40	02FB 002A	FILES = RIGHTS(STR\$(POINTERR%)-1) +
	02FB 002A	"PAT.RJP"
	031C 002E	KILL FILES
	0323 002E	
45	0323 002E	'rename remaining data files to maintain linked
		list with directory
	0323 002E	WHILE (PATNUM% + 1) > POINTERR%
	0333 002E	SFILES = RIGHTS(STR\$(POINTERR%+1),LEN(STR\$(POINT
		ERR%+1))-1) + "PAT.RJP"
	0359 0032	DFILES = RIGHTS(STR\$(POINTERR%),LEN(STR\$(POINT
50		ERR%+1) + "PAT.RJP"
	037D 0036	NAME SFILES AS DFILES
	0387 0036	POINTERR% = POINTERR% + 1
	039C 0036	WEND
55	0393 0036	GOSUB MESSAGE.OFF
	0393 0036	PATNAME = SELNAME
	0399 0036	GOSUB T3A
	03A3 0036	GOSUB DISP.DIR
	03A9 0036	

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Reagent Jet Printer  
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30

Offset	Data	Source Line
03AF	0036	RETURN
03B3	0036	
03B3	0036	REM SPAGE

35

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0393 0036 039: Copy pattern
      039E 0036 TYPEZ = 0
      03BF 0036 IF PATNUM1 = 80 THEN FLAGZ = 3:GOSUB SHOW.ERROR:RETURN
      03DE 0036 FUNCTS = "Copy"
10     03E5 0036 GOSUB GET.SOURCE
      03EB 0036 IF LEN(NEWNAMES) = 0 THEN RETURN
      03FC 0036 GOSUB SEARCH
      0407 0036 IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
      041F 0036
15     041F 0036 GOSUB GET.NEW.NAME
      0425 0036 IF LEN(NEWNAMES) = 0 THEN RETURN
      0437 0036 IF LEN(NEWNAMES) > 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
      RETURN
      0457 003A
20     0457 003A MESSAGES = "Copying " + PATNAMES + " to " + NEWNAMES +
      " Please wait.."
      047C 003A GOSUB MESSAGE.ON
      0482 003A
      0482 003A 'add NEWNAMES at end of directory
25     0482 003A KILL "PATDIR.CLD"
      0489 003A MAKE "PATDIR.RJP" AS "PATDIR.CLD"
      0493 003A OPEN "PATDIR.CLD" FOR INPUT AS #1
      04A4 003A OPEN "PATDIR.RJP" FOR OUTPUT AS #2
      04B6 003A
30     04B6 003A INPUT #1, PATNUMZ
      04CB 003A PATNUMZ = PATNUMZ + 1
      04D1 003A WRITE #2,PATNUMZ
      04E2 003A
      04E2 003A FOR IZ = 1 TO PATNUMZ - 1
35     04F1 003C INPUT #1,TEMPZ
      0503 0040 PRINT #2,TEMPZ
      0513 0040 NEXT IZ
      0525 0040 PRINT #2,NEWNAMES
      0535 0040
40     0535 0040 CLOSE #1:CLOSE #2
      0543 0040
      0543 0040 'create copy of pattern data file
      0543 0040 FILES = RIGHTS(STR$(POINTERZ),LEN(STR$(POINTERZ))-1) +
      "PAT.RJP"
45     0567 0040 NEWFILES = RIGHTS(STR$(PATNUMZ),LEN(STR$(PATNUMZ))-1) +
      "PAT.RJP"
      058B 0044
      058B 0044 OPEN FILES FOR INPUT AS #1
      059C 0044 OPEN NEWFILES FOR OUTPUT AS #2
50     05AE 0044
      05AE 0044 INPUT #1,ELNUMZ
      05C0 0046 WRITE #2,ELNUMZ
      05D1 0046
      05D1 0046 FOR IZ = 1 TO 4
55     05DB 0046 INPUT #1,TEMP
      05EA 004A WRITE #2,TEMP
      05FA 004A NEXT IZ
      060A 004A
      060A 004A FOR IZ = 1 TO ELNUMZ

```

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	Offset	Data	Source Line
5	0617	004C	FOR JZ = 1 TO 6
	061E	004C	INPUT #1,TEMPZ
	0630	004E	WRITE #2,TEMPZ
	0641	004E	NEXT JZ
10	0651	0050	NEXT IZ
	0663	0050	CLOSE #1:CLOSE #2
	0663	0050	
	0671	0050	
	0671	0050	GOSUB MESSAGE.OFF
15	0677	0050	GOSUB DISP.DIR
	067D	0050	RETURN
	0681	0050	
	0681	0050	T3C: 'rename pattern
	0686	0050	TYPEZ = 0
20	068D	0050	FUNCTS = 'Rename'
	0697	0050	GOSUB GET.SOURCE
	069D	0050	IF LEN(PATNAMES) = 0 THEN RETURN
	06AF	0050	GOSUB SEARCH
	06B5	0050	IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN
25	06D1	0050	
	06D1	0050	GOSUB GET.NEW.NAME
	06D7	0050	IF LEN(NEWNAMES) = 0 THEN RETURN
	06E9	0050	IF LEN(NEWNAMES) > 15 THEN FLAGZ = 2:GOSUB SHOW.ERROR:R
			ETURN
30	0709	0050	IF NEWNAMES = PATNAMES THEN RETURN
	071C	0050	
	071C	0050	MESSAGES = 'Renaming ' + PATNAMES + ' to ' + NEWNAMES +
			' Please wait...'
	0741	0050	GOSUB MESSAGE.ON
35	0747	0050	
	0747	0050	'change pattern name in directory replacing PAT
			NAMES with NEWNAMES
	0747	0050	KILL 'PATDIR.OLD'
40	074E	0050	NAME 'PATDIR.RJP' AS 'PATDIR.OLD'
	0756	0050	OPEN 'PATDIR.OLD' FOR INPUT AS #1
	0769	0050	OPEN 'PATDIR.RJP' FOR OUTPUT AS #2
	077B	0050	
	077B	0050	INPUT #1, PATNUMZ
	078D	0050	WRITE #2,PATNUMZ
45	079E	0050	
	079E	0050	FOR IZ = 1 TO PATNUMZ
	07A8	0052	INPUT #1,TEMPZ
	07BD	0052	IF IZ <> POINTERZ THEN PRINT #2,TEMPZ
	07DA	0052	IF IZ = POINTERZ THEN PRINT #2,NEWNAMES
50	07F7	0052	NEXT IZ
	0809	0052	
	0809	0052	CLOSE #1:CLOSE #2
	0817	0052	
	0817	0052	GOSUB MESSAGE.OFF
55	081D	0052	
	081D	0052	'select new pattern name if necessary
	081D	0052	IF PATNAMES = SELNAMES THEN PATNAMES = NEWNAMES:GOSUB T
			30A
	083C	0052	GOSUB DISP.DIR

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

5  
0842 0052 RETURN  
0846 0052  
10 0846 0052 REM \$PAGE

15

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Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

20

0846 0052 T3D: 'select pattern for printing  
0848 0052 TYPEZ = 0  
0852 0052 FUNCT\$ = 'Select'  
085C 0052 GOSUB GET.SOURCE  
25 0862 0052 IF LEN(PATNAME\$) = 0 THEN RETURN  
0874 0052 IF PATNAME\$ = SELNAME\$ THEN RETURN  
0887 0052 GOSUB T3DA  
088D 0052 GOSUB DISP.DIR  
0893 0052 RETURN  
30 0897 0052  
0897 0052 T3DA:  
089C 0052 GOSUB SEARCH  
08A2 0052 IF POINTERZ = 0 THEN FLAGZ = 1:GOSUB SHOW.ERROR:RETURN  
08BE 0052  
35 08BE 0052 MESSAGE\$ = 'Selecting ' + PATNAME\$ + ' Please Wait.  
..  
08D5 0052 GOSUB MESSAGE.ON  
08DB 0052  
08DB 0052 'change entrys in pattern default file PATDEF.R  
40 08DB 0052 JP  
08DB 0052 OPEN "PATDEF.RJP" FOR OUTPUT AS #1  
08ED 0052 FILE\$ = RIGHT\$(STR\$(POINTERZ),LEN(STR\$(POINTERZ))-1) +  
"PAT.RJP"  
45 0911 0052  
0911 0052 PRINT #1,FILE\$  
0921 0052 PRINT #1,PATNAME\$  
0931 0052  
0931 0052 CLOSE #1  
0938 0052 GOSUB MESSAGE.OFF  
50 093E 0052 RETURN  
0942 0052  
0942 0052 T3E: 'exit pattern filing  
0947 0052 RETURN  
0948 0052  
55 0948 0052 REM \$PAGE

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```

5      Offset Data Source Line
      0948 0052 SEARCH:
      0950 0052     POINTERZ = 0
      0957 0052     OPEN "PATDIR.RJP" FOR INPUT AS #1
      0968 0052     INPUT #1,PATNUMZ: ' get number of patterns in direc
10          lory
      097A 0052     IF PATNUMZ = 0 THEN CLOSE #1:RETURN
      0990 0052     TEMP$ = ""
      099A 0052     WHILE (POINTERZ < PATNUMZ) AND (PATNAME$ <> TEMP$)
15      09C2 0052         LINE INPUT #1,TEMP$
      09CF 0052         POINTERZ = POINTERZ + 1
      09DB 0052     WEND
      09DB 0052     IF PATNAME$ <> TEMP$ THEN POINTERZ = 0
      09F1 0052     CLOSE #1
      09FB 0052     RETURN
20      09FC 0052
      09FC 0052 GET.SOURCE:
      0A01 0052     LOCATE 25,1:COLOR 15,0:PRINT "Enter Pattern Name to "FU
25          WCT$ " ";
      0A33 0052     LINE INPUT: "",PATNAME$
      0A41 0052     LOCATE 25,1:PRINT SPACES(79);
      0A5E 0052     RETURN
      0A62 0052
      0A62 0052 GET.NEW.NAME:
      0A67 0052     LOCATE 25,1:COLOR 15,0:PRINT "Enter New Pattern Name ";
30      0A80 0052     LINE INPUT: "",NEWNAME$
      0A9B 0052     LOCATE 25,1:PRINT SPACES(79);
      0ABB 0052     RETURN
      0ABC 0052
      0ABC 0052 DISP.DIR: 'display directory in 4 columns, 20 rows
35      0AC1 0052     'read default pattern name into SELNAME$
      0AC1 0052     OPEN "PATDEF.RJP" FOR INPUT AS #1
      0AD2 0052     INPUT #1,SELNAME$: 'discard data file name
      0AE4 0052     INPUT #1,SELNAME$
40      0AF6 0052     CLOSE #1
      0AFD 0052
      0AFD 0052     OPEN "PATDIR.RJP" FOR INPUT AS #1
      0B0E 0052     INPUT #1,PATNUMZ: ' read number of patterns
      0B20 0052
      0B20 0052     MESSAGE$ = "Reading Pattern Directory Please Wait"
45      0B2A 0052     GOSUB MESSAGE.ON
      0B30 0052     FLAGZ = 0
      0B37 0052     TEMPZ = PATNUMZ - 1: IF PATNUMZ < 80 THEN TEMPZ = PATNUM
50          Z
      0B52 0052     FOR IZ = 0 TO TEMPZ
      0B5E 0054         LOCATE (IZ MOD 20)+1,(INT(IZ/20)*20)+1
      0B91 0054         PRINT SPACES(18);
      0BA1 0054     NEXT IZ
      0BB3 0054
      0BB3 0054     FOR IZ = 0 TO PATNUMZ - 1
55      0BC1 0056         INPUT #1,PATNAME$
      0BD3 0056         LOCATE (IZ MOD 20)+1,(INT(IZ/20)*20)+3
      0C06 0056         PRINT PATNAME$:
      0C13 0056         IF PATNAME$ = SELNAME$ THEN LOCATE (IZ MOD 20)+
          1,(INT(IZ/20)*20)+1:PRINT "*";

```

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Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0C62 0056      NEXT IZ
      0C77 0056      CLOSE #1
      0C7E 0056      GOSUB MESSAGE.OFF
      0C84 0056      RETURN
10     0C86 0056
      0C8E 0056      INITIALIZE:
      0C8D 0056      DIM MENU$(4,1)
      0C8E 007E      MENU$(0,0) = "Delete"
      0CA6 007E      MENU$(0,1) = "Remove a pattern file from the directory"
15     0CC1 007E      MENU$(1,0) = "Copy"
      0CDC 007E      MENU$(1,1) = "Copy a pattern file to a new pattern name

      0CF5 007E      MENU$(2,0) = "Rename"
      0D12 007E      MENU$(2,1) = "Rename a pattern file in the directory"
20     0D30 007E      MENU$(3,0) = "Select"
      0D48 007E      MENU$(3,1) = "Select a pattern file to be printed"
      0D67 007E      MENU$(4,0) = "Exit"
      0D82 007E      MENU$(4,1) = "Return to the main menu"
      0D9E 007E
25     0D9E 007E      COLOR 9,0:CLS
      0DB1 007E      LOCATE 21,1
      0DBE 007E      FOR IZ = 1 TO 80
      0DC5 007E          PRINT "D";
      0DD2 007E      NEXT IZ
30     0DE2 007E
      0DE2 007E      FOR MENUZ = 0 TO 4
      0DEB 007E          GOSUB MENU.OFF
      0DEE 007E      NEXT MENUZ
      0DFE 007E
35     0DFE 007E      GOSUB DISP.DIR
      0E04 007E      IF FLAGZ > 0 THEN GOSUB SHOW.ERROR
      0E15 007E      MENUZ = 4
      0E1C 007E      GOSUB MENU.ON
      0E22 007E
40     0E22 007E      RETURN
      0E26 007E
      0E26 007E      NEW.MENU:
      0E2B 007E          GOSUB MENU.OFF
      0E31 007E          MENUZ = MENUZ + DIFFZ
45     0E3D 007E          GOSUB MENU.ON
      0E43 007E      RETURN
      0E47 007E
      0E47 007E      MENU.ON:
      0E4C 007E          LOCATE 22,(MENUZ+10)+18
50     0E63 007E          COLOR 0,7
      0E6F 007E          PRINT MENU$(MENUZ,0);
      0E8D 007E          LOCATE 25,40-LEN(MENU$(MENUZ,1))/2
      0EC1 007E          COLOR 7,0
      0ECD 007E          PRINT MENU$(MENUZ,1);
55     0EEC 007E      RETURN
      0EF0 007E
      0EF0 007E      MENU.OFF:
      0EF5 007E          LOCATE 22,(MENUZ+10)+18
      0F0C 007E          COLOR 14,0

```



Reagent Jet Printer  
Pattern Filing

PAGE 13

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15:11:46

IBM Personal Computer BASIC Compiler V2.00

	Offset	Data	Source Line
5	0F19	007E	PRINT MENU\$(MENU\$,0);
	0F36	007E	LOCATE 25,40-LEN(MENU\$(MENU\$,1))/2
	0F6A	007E	PRINT SPACES(LEN(MENU\$(MENU\$,1)));
10	0F8F	007E	RETURN
	0F93	007E	
	0F93	007E	SHOW.ERROR:
	0F98	007E	ON FLAG\$ GOSUB ER1, ER2, ER3, ER4
	0FA9	007E	ERRMSG\$ = ERR\$ + " Strike any key.."
15	0FB9	0086	LOCATE 24,40-LEN(ERRMSG\$)/2
	0FDB	0086	COLOR 13,0
	0FE7	0086	PRINT ERRMSG\$;
	0FF4	0086	AS = ""
	0FFE	0086	WHILE AS = ""
20	100D	0086	AS = INKEY\$
	1017	0086	WEND
	101A	0086	GOSUB MESSAGE.OFF
	1020	0086	RETURN
	1024	0086	
25	1024	0086	ER1:
	1029	0086	ERR\$ = PATNAME\$ + " Not Found in the Directory"
	1039	0086	RETURN
	103D	0086	
	103D	0086	ER2:
30	1042	0086	ERR\$ = "Pattern Name is too Long (15 characters max.)"
	104C	0086	RETURN
	1050	0086	
	1050	0086	ER3:
	1055	0086	ERR\$ = "Directory is Full (60 patterns max.)"
35	105F	0086	RETURN
	1063	0086	
	1063	0086	ER4:
	1068	0086	ERR\$ = "Cannot Modify SELECTd pattern Name"
	1072	0086	RETURN
40	1076	0086	
	1076	0086	MESSAGE.ON:
	1078	0086	LOCATE 24,38 - LEN(MESSAGE\$) / 2:COLOR 11,0:PRINT MESSA
			GE\$;
	1086	0086	RETURN
45	108A	0086	
	108A	0086	
	108A	0086	MESSAGE.OFF:
	10BF	0086	LOCATE 24,1:COLOR 15,0:PRINT SPACES(79);
	10EB	0086	RETURN
50	10EC	0086	
	10EC	0086	END SUB
	10F3	0086	
	1668	0086	

50426 Bytes Available  
45670 Bytes Free

0 Warning Error(s)  
0 Severe Error(s)

Reagent Jet Printer  
Main Line Code

PAGE 1  
07-09-86  
15:27:04

Offset Data Source Line IEM Personal Computer BASIC Compiler V2.00

```

5      0030 0006 REM $TITLE: 'Reagent Jet Printer' $SUBTITLE: 'Main Line Code'
      0030 0006
      0030 0006 'MODULE - "MAIN"
      0030 0006
10     0030 0006 'AUTHOR - M. A. Enevold
      0030 0006
      0030 0006 'COPYRIGHT (C) 1986 ABBOTT LABORATORIES
      0030 0006
      0030 0006 'REVISION - 1.1 02-19-86 NAE Add notes and revise TYPEZ resetin
15     9
      0030 0006 ' - 1.0 02-14-86 NAE Creation of initial code
      0030 0006
      0030 0006 'SYSTEM - This code can only be compiled by the BASCCM
      0030 0006 ' COMPILER, it will not run under the INTERPRETER!!
20     0030 0006
      0030 0006 'DESCRIPTION
      0030 0006 ' This is the main controlling module for the Reagent Jet
      0030 0006 ' Printer.
      0030 0006 ' It displays a menu in table form that allows 6 function
25     s to be
      0030 0006 ' selected. PATTERN DEFINITION allows the user to define
      0030 0006 ' patterns
      0030 0006 ' to be printed. PATTERN FILING lets the user delete, co
      0030 0006 ' py, rename
30     0030 0006 ' and select patterns for printing. REAGENT CALIBRATION
      0030 0006 ' permits setting
      0030 0006 ' of operation parameters for different reagents. REAGEN
      0030 0006 ' T FILING is
35     0030 0006 ' the same as pattern filing. PRINTING PRINT prints the
      0030 0006 ' selected
      0030 0006 ' pattern with the selected reagent. SYSTEM EXIT TO DOS
      0030 0006 ' ends the session.
      0030 0006 ' Using up and down arrow keys let the user move through
40     the menu and
      0030 0006 ' the Enter (cr) key activates the selection.
      0030 0006
      0030 0006 'DATA DICTIONARY
      0030 0006 ' MENUZ This value represents the current menu
      0030 0006 ' item (0-5)
45     0030 0006 ' MENU$(5,1) String array for displaying menu items.
      0030 0006 ' 6 rows by 2 columns
      0030 0006 ' Each row corresponds to a menu item (0-
      0030 0006 ' 5)
      0030 0006 ' First column is short menu name in high
50     lighted area
      0030 0006 ' Second column is long description displ
      0030 0006 ' ayed at menu bottom
      0030 0006 ' MROWZ(5) This array stores to row in which the s
      0030 0006 ' hort menu name will be displayed
55     0030 0006 ' DIFFZ This value is used it change MENUZ in r
      0030 0006 ' esponse to arrow keys
      0030 0006 ' TYPEZ This value is set based on which valid
      0030 0006 ' key is pressed
      0030 0006 ' 0 = No valid key. 1 = Up Arrow. 2 = 0

```

Reagent Jet Printer  
Main Line Code

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IBM Personal Computer BASIC Compiler V2.00

Offset Data Source Line

```

0030 0006      own Arrow. 3 = (cr).
                TEMP1
                reshed
0030 0006      As
0030 0006      Cs
                rs used in drawing the menu table
0030 0006      Iz
0030 0006      Rz
                is displayed
0030 0006      Cz
                ter is displayed
0030 0006      REM $PAGE

```

Used to store MENUZ while screen is ref  
Used to store single input keystrokes  
Used to store special graphics character  
Counter used to refresh display  
Row in which special graphics character  
Column in which special graphics character

Reagent Jet Printer  
Main Line Code

PAGE 3

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15:27:04

IBM Personal Computer BASIC Compiler V2.00

Offset Data Source Line

```

0030 0006
0030 0006      Main-line code for RJP Reagent Jet Printer
0030 0006      MAIN.LINE.CODES:
0030 0006      GOSUB INITIALIZE
0043 0006      WHILE TYPEZ (<) 3
0046 0006
0056 0008      TYPEZ = 0
0056 0008      As = ""
0067 000C      WHILE As = ""
0076 000C      As = INKEYS
0080 000C      WEND
0083 000C      IF As = CHR$(0) + CHR$(72) THEN TYPEZ = 1:
0083 000C      up arrow
00A8 000C      IF As = CHR$(0) + CHR$(80) THEN TYPEZ = 2:
00CD 000C      down arrow
00E7 000C      IF As = CHR$(13) THEN TYPEZ = 3:
00E7 000C      (cr) execute command
00F6 000C      ON TYPEZ GOSUB T1, T2, T3
00FA 000C      WEND
00FA 000C      CLS
0101 000C      COLOR 7,0,0
0112 000C      SYSTEM
0116 000C      REM $PAGE

```

Reagent Jet Printer  
Main Line Code

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15:27:04

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

```

5      0116 000C '***** SUB-ROUTINES FOR MAIN PROGRAM
10     0116 000C T1: 'up arrow
      0118 000C 'IF MENUZ = 0 THEN RETURN
      012A 000E 'DIFFZ = -1
      0131 0010 'GOSUB NEW.MENU
      0137 0010 'RETURN
15     013B 0010
      013B 0010 T2: 'down arrow
      0140 0010 'IF MENUZ = 5 THEN RETURN
      014F 0010 'DIFFZ = 1
      0156 0010 'GOSUB NEW.MENU
20     015C 0010 'RETURN
      0160 0010
      0160 0010 T3:
      0165 0010 'ON MENUZ + 1 GOSUB T31, T32, T33, T34, T35, T36
      017C 0010 'IF MENUZ < 5 THEN TYPEZ = 0: reset TYPEZ so program
25     'won't end
      018E 0010 'SCREEN 0,0,3,3
      01A5 0010 'RETURN
      01A9 0010
      01A9 0010 T31: 'pattern definition
30     01AE 0010 'CALL PATENTRY: 'in module PATENT
      01BA 0010 'GOSUB REFRESH
      01C0 0010 'RETURN
      01C4 0010
      01C4 0010 T32: 'pattern filing
35     01C9 0010 'SCREEN 0,0,0,0:CLS
      01E5 0010 'CALL PATTERN.FILE: 'in module PATFILE
      01F1 0010 'RETURN
      01F5 0010
      01F5 0010 T33: 'reagent calibration
40     01FA 0010 'CALL REAGENT.CALIBRATE: 'in module REACAL
      0206 0010 'RETURN
      020A 0010
      020A 0010 T34: 'reagent filing menu
      020F 0010 'SCREEN 0,0,0,0:CLS
45     022B 0010 'CALL REAGENT.FILE: 'in module REAFILE
      0237 0010 'RETURN
      023B 0010
      023B 0010 T35: 'print pattern
      0240 0010 'CALL PATPRINT: 'in module PATPRINT
50     024C 0010 'RETURN
      0250 0010
      0250 0010 T36: 'exit system, don't reset TYPEZ
      0255 0010 'RETURN
      0259 0010
55     0259 0010 REM $PAGE

```

Reagent Jet Printer  
Main Line Code

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IBM Personal Computer BASIC Compiler V2.00

	Offset	Data	Source Line
5	0259	0010	NEW.MENU:
	025E	0010	GOSUB MENU.OFF
	0264	0010	MENUZ = MENUZ + DIFFZ
	0270	0010	GOSUB MENU.ON
10	0276	0010	RETURN
	027A	0010	
	027A	0010	INITIALIZE:
	027F	0010	CALL PCI.INIT
	028B	0010	
15	028B	0010	define and initialize arrays
	028B	0010	DIM MROWZ(5)
	028C	0010	MROWZ(0) = 4
	028E	0010	MROWZ(1) = 6
	0291	0010	MROWZ(2) = 10
20	02C4	0010	MROWZ(3) = 12
	02D7	0010	MROWZ(4) = 16
	02EA	0010	MROWZ(5) = 20
	02FD	0010	
	02FD	0010	DIM MENUZ(5,1)
25	02FE	004C	RESTORE MENU.STRING.DATA
	0305	004C	FOR IZ = 0 TO 5
	030B	004C	READ MENUZ(IZ,0),MENUZ(IZ,1)
	033B	004E	NEXT IZ
	034B	004E	
30	034B	004E	set initial values into variables
	034B	004E	TYPEZ = 0
	0352	004E	MENUZ = 0
	0357	004E	
	0359	004E	REFRESH: redraw screen and highlight current menu selection
35	035E	004E	
	035E	004E	SCREEN 0,0,0:CLS:COLOR 7,0,0
	036B	004E	LOCATE 10,32:PRINT "Loading Menu....."
	03A5	004E	SCREEN 0,0,0:CLS
	03C2	004E	
40	03C2	004E	COLOR 13,0
	03CE	004E	LOCATE 1,3:
	03DB	004E	PRINT "REAGENT JET PRINTER";
	03EB	004E	COLOR 10,0
45	03F4	004E	LOCATE 5,26
	0401	004E	PRINT "PATTERN"
	040E	004E	LOCATE 11,26
	041B	004E	PRINT "REAGENT"
	0428	004E	LOCATE 16,26
50	0435	004E	PRINT "PRINTING"
	0442	004E	LOCATE 20,27
	044F	004E	PRINT "SYSTEM"
	045C	004E	
	045C	004E	draw the menu table in special graphics characters
55	045C	004E	COLOR 9,0
	046B	004E	FOR IZ = 16 TO 63
	046F	004E	LOCATE 2,IZ:PRINT "0";
	048A	004E	LOCATE 3,IZ:PRINT "0";
	04A5	004E	LOCATE 14,IZ:PRINT "0";

Reagent Jet Printer  
Main Line Code

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IBM Personal Computer BASIC Compiler V2.00

Offset	Data	Source Line
5	04C0 004E	LOCATE 19,12:PRINT "D";
	04C8 004E	LOCATE 22,12:PRINT "D";
	04F6 004E	LOCATE 24,12:PRINT "D";
	0511 004E	NEXT IZ
10	0524 004E	FOR IZ = 3 TO 23
	052B 004E	LOCATE 12,17:PRINT "J";
	0546 004E	LOCATE 12,64:PRINT "J";
	0561 004E	NEXT IZ
	0571 004E	RESTORE TABLE
15	0578 004E	FOR IZ = 1 TO 12
	057F 004E	READ R1,C1,C5
	0592 0056	LOCATE R1,C1:PRINT C5;
	05AE 0056	NEXT IZ
	05BE 0056	
20	05BE 0056	print the instructions
	05BE 0056	COLOR 7,0
	05CA 0056	LOCATE 25,6
	05D7 0056	PRINT "Use or to highlight menu items. Use to activate selection.";
25	05E4 0056	
	05E4 0056	COLOR 15,0
	060A 0056	LOCATE 25,15:PRINT "I";
	0624 0056	LOCATE 25,47:PRINT "DY";
30	063E 0056	
	063E 0056	display the 6 menu choices
	063E 0056	TEMP1 = MENUZ
	0645 0058	FOR MENUZ = 0 TO 5
	064B 0058	GOSUB MENU.OFF
35	0651 0058	NEXT MENUZ
	0661 0058	MENUZ = TEMP1
	0668 0058	
	0668 0058	highlight the currently active menu item
	0668 0058	GOSUB MENU.ON
40	066E 0058	
	066E 0058	SCREEN 0,0,3,3
	0685 0058	RETURN
	0689 0058	
	0689 0058	MENU.ON: highlight the menu MENUZ and display its long description
45	068E 0058	ion
	069A 0058	COLOR 0,7
	06DA 0058	LOCATE MROWZ(MENUZ),52-LEN(MENUS(MENUZ,0))/2
	06FB 0058	PRINT MENUS(MENUZ,0);
	0704 0058	COLOR 7,0
50	0704 0058	LOCATE 23,40.5-LEN(MENUS(MENUZ,1))/2
	0733 0058	PRINT MENUS(MENUZ,1);
	0757 0058	RETURN
	0758 0058	
	0758 0058	MENU.OFF: un-highlight menu MENUZ and erase long description
55	0760 0058	COLOR 14,0
	076C 0058	LOCATE MROWZ(MENUZ),52-LEN(MENUS(MENUZ,0))/2
	07AC 0058	PRINT MENUS(MENUZ,0);
	07CA 0058	COLOR 7,0
	07D6 0058	LOCATE 23,40.5-LEN(MENUS(MENUZ,1))/2

5

10

15

20

25

Reagent Jet Printer  
Main Line Code

PAGE 7  
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15:27:04

Offset Data Source Line IBM Personal Computer BASIC Compiler V2.00

30

080A 005B PRINT SPACES(LEN(MENU(MENU,1)));  
082F 005B RETURN  
0833 005B  
0833 005B REM \$PAGE

35

40

45

50

55

Reagent Jet Printer  
Main Line Code

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15:27:04

```

5      Offset Data   Source Line      IBM Personal Computer BASIC Compiler V2.00

      0833 0058 ***** DATA FIELDS USED BY THE MAIN PROGRAM *****
      0833 0058
      0833 0058 MENU.STRING.DATA:      'first entry is menu name, second is lo
10      ng description

      0838 0058
      0838 0058      DATA 'DEFINITION', 'Create and Modify Patterns'
      083A 0058      DATA 'FILING',      'Delete, Copy, Rename, and Select Pa
      tterns'
15      083C 0058      DATA 'CALIBRATION', 'Calibrate and Modify Reagent Profil
      es'
      083E 0058      DATA 'FILING',      'Delete, Copy, Rename, and Select Re
      agents'
      0840 0058      DATA 'PRINT',      'Print Selected Pattern with Selecte
20      d Reagent'
      0842 0058      DATA 'EXIT TO DOS', 'Leave Program and Return to DOS'
      0844 0058
      0844 0058 TABLE: 'first entry is row, second is column, third is special
      graphics character

25      0849 0058
      0849 0058      DATA 2,17,'Z'
      084B 0058      DATA 2,64,'?'
      084D 0058      DATA 8,17,'C'
      084F 0058      DATA 8,64,'4'
30      0851 0058      DATA 14,17,'C'
      0853 0058      DATA 14,64,'4'
      0855 0058      DATA 18,17,'C'
      0857 0058      DATA 18,64,'4'
      0859 0058      DATA 22,17,'C'
35      085B 0058      DATA 22,64,'4'
      085D 0058      DATA 24,17,'8'
      085F 0058      DATA 24,64,'Y'
      0861 0058
      0861 0058      END
40      0865 0058
      0842 0058

```

50426 Bytes Available  
47680 Bytes Free

0 Warning Error(s)  
0 Severe Error(s)

## 50 Claims

1. A dispensing system for use in diagnostic instruments for precise metering of a desired diagnostic fluid, the system comprising:

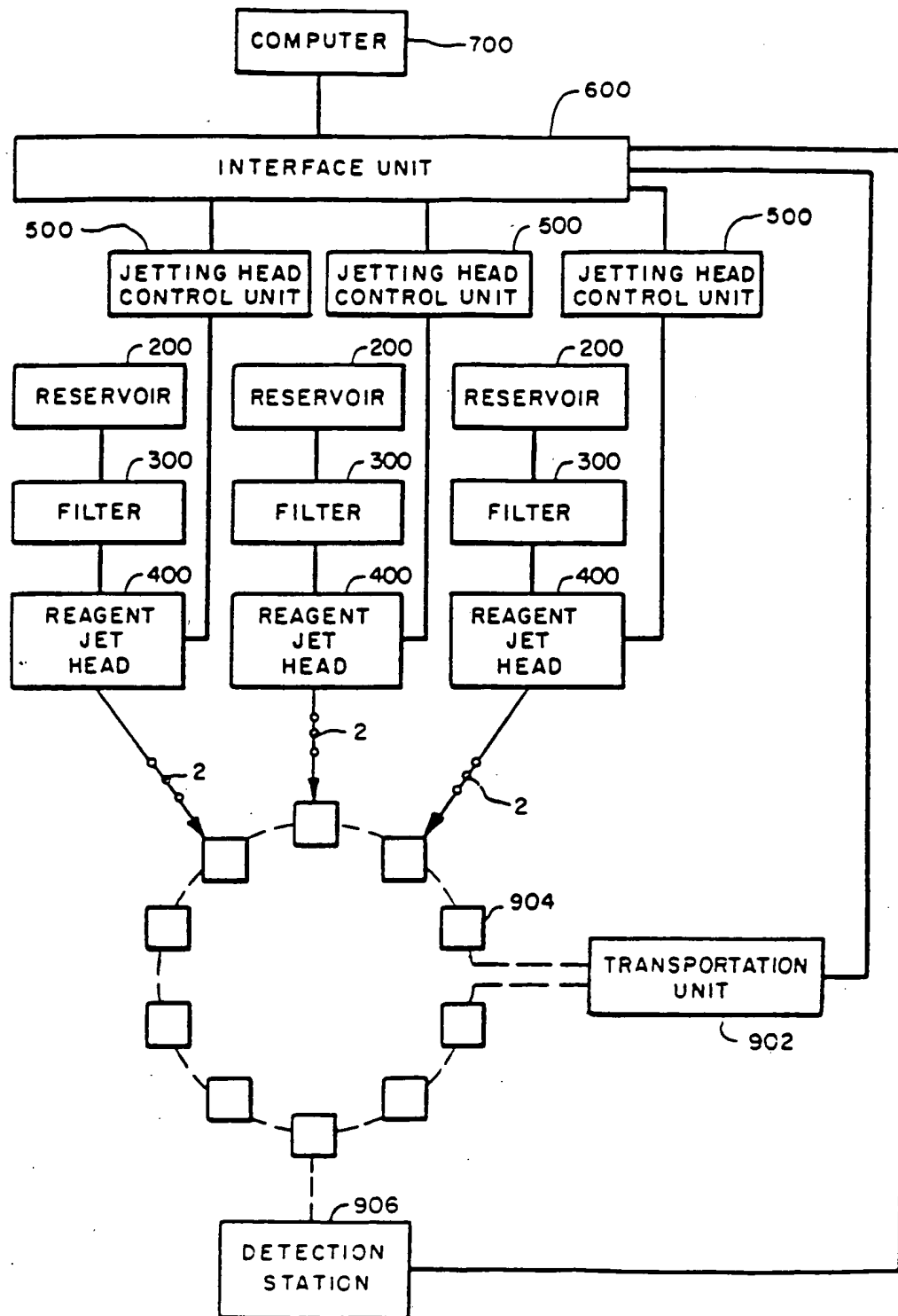
- 55 a jetting chamber defining a volume and comprising a first and second aperture, the first aperture adapted to receive diagnostic fluid, the second aperture defining an orifice;  
a transducer in mechanical communication with the jetting chamber, the transducer operative to alternately expand and de-expand the volume of the jetting chamber in response to a selected electrical pulse and



thereby cause the jetting chamber to emit a substantially uniformly sized droplet of diagnostic fluid through the orifice; and  
 means for generating a number of electrical pulses sufficient to cause a desired quantity of the diagnostic fluid to be dispensed.

2. The invention of Claim 1 wherein the system further comprises:  
 at least one additional jetting chamber in fluid communication with an additional diagnostic fluid;  
 at least one additional transducer in mechanical communication with the additional jetting chamber;  
 at least one additional means for applying an electrical pulse to the additional transducer;  
 means for generating respective numbers of electrical pulses sufficient to cause precise quantities of the  
 diagnostic fluids to be dispensed in a desired volumetric ratio; and  
 a receptacle adapted for and positioned to receive the fluids.
3. The invention of Claim 1 wherein the system further comprises:  
 means for directing at least one of (1) the receptacle and (2) the emitted diagnostic fluid and the emitted  
 additional diagnostic fluid such that desired quantities of the fluids are dispensed into the receptacle in a  
 predefined dispensing order.
4. The invention of Claim 1 wherein one of the diagnostic fluids comprises serum and wherein the  
 jetting chambers cooperate such that the other diagnostic fluid is emitted in a manner to contact and mix  
 with the serum.
5. The invention of Claim 1 wherein the jetting chamber comprises a cylindrical tube and wherein the  
 transducer is mounted concentrically about the cylindrical tube.
6. The invention of Claim 1 wherein the jetting chamber is conically shaped.
7. The invention of Claim 1 wherein the jetting chamber comprises at least one chamber wall which is  
 integrally formed with the transducer.
8. The invention of Claim 1 wherein the transducer is one of (1) a piezo-electric transducer; (2) a  
 magneto-strictive transducer; (3) an electro-strictive transducer; and (4) an electro-mechanical transducer.
9. The invention of Claim 1 wherein the jetting chamber is conically shaped; and wherein the transducer  
 is disc shaped and forms the base of the conically shaped jetting chamber.
10. The invention of Claim 1 wherein the orifice comprises an end face and the end face is coated with  
 a hydrophobic polymer.
11. The invention of Claim 1 wherein the transducer is cylindrically shaped and comprises a first  
 electrode located on the inner wall of the cylinder and wraps around one end of the cylinder and wherein a  
 second electrode is located substantially on the outer wall of the cylinder and is electrically isolated from  
 the first electrode.
12. The invention of Claim 1 wherein the means for generating produces an electrical pulse of selected  
 rise and fall time constants and of selected duration, voltage and polarity.
13. The invention of Claim 1 wherein the means for generating the electrical pulse comprises means for  
 scaling the voltage of the pulse in response to a selectable digital value.
14. The invention of Claim 1 wherein the apparatus further comprises means for directing the emitted  
 diagnostic fluid along a desired path.
15. A method of dispensing precise quantities of diagnostic fluids comprising the steps of:  
 (a) generating an electrical pulse of predefined characteristics;  
 (b) reducing the volume of a chamber containing the diagnostic fluid by electro-mechanical means in  
 response to the electrical pulse such that a droplet of fluid of known volume is propelled through an orifice  
 in the chamber; and  
 (c) repeating steps (a) and (b) until a desired quantity of the diagnostic fluid has been dispensed.

FIG. 1



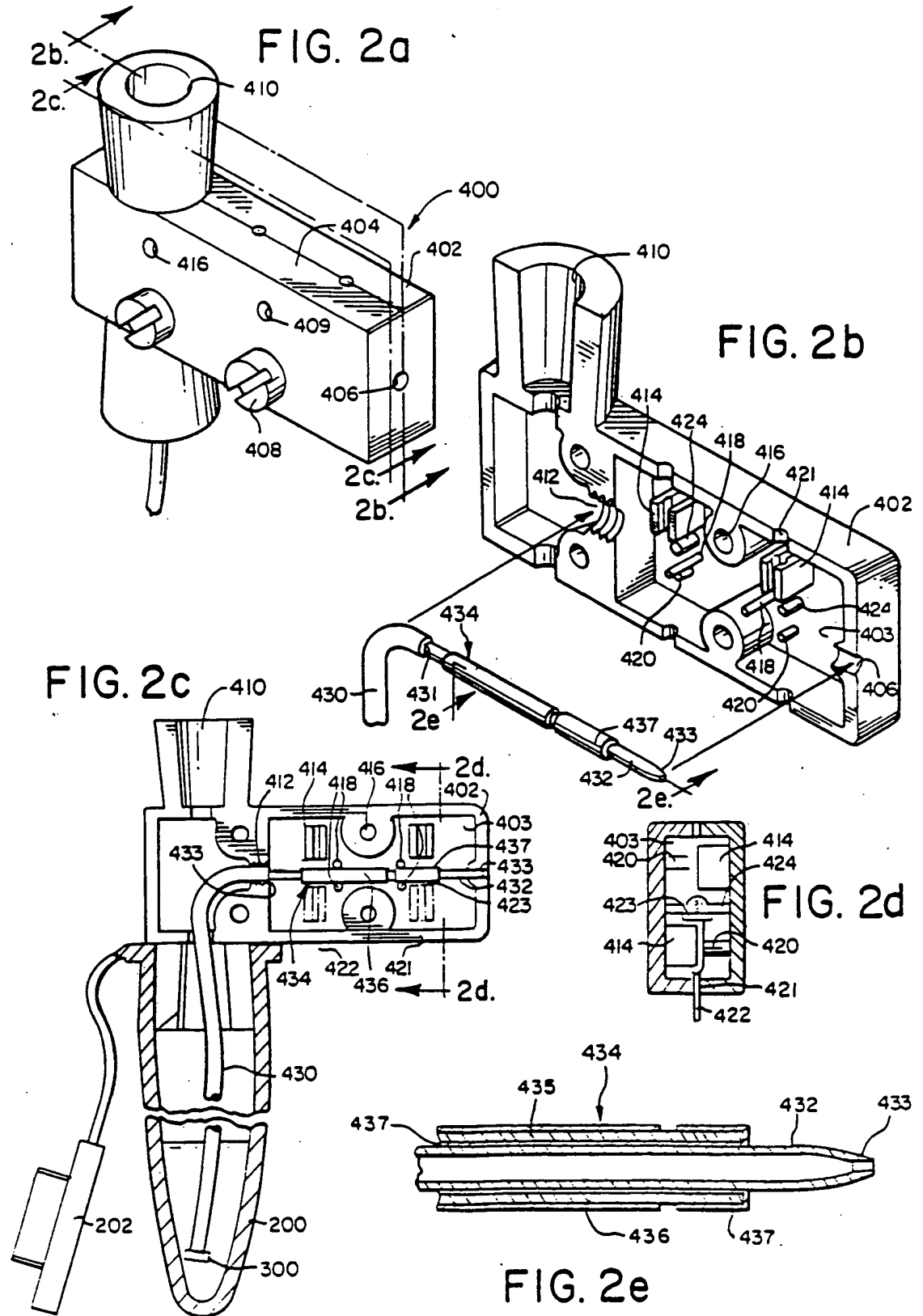


FIG. 3

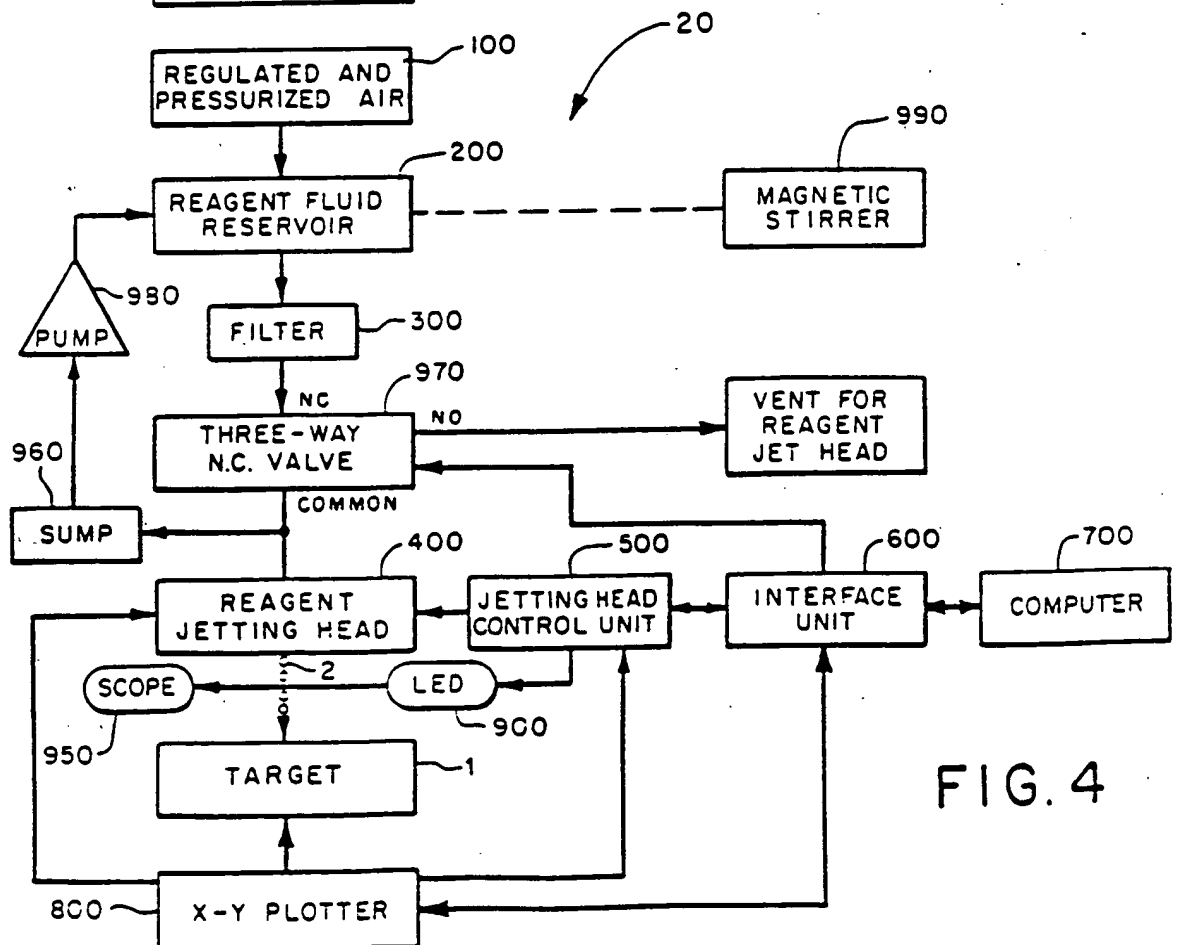
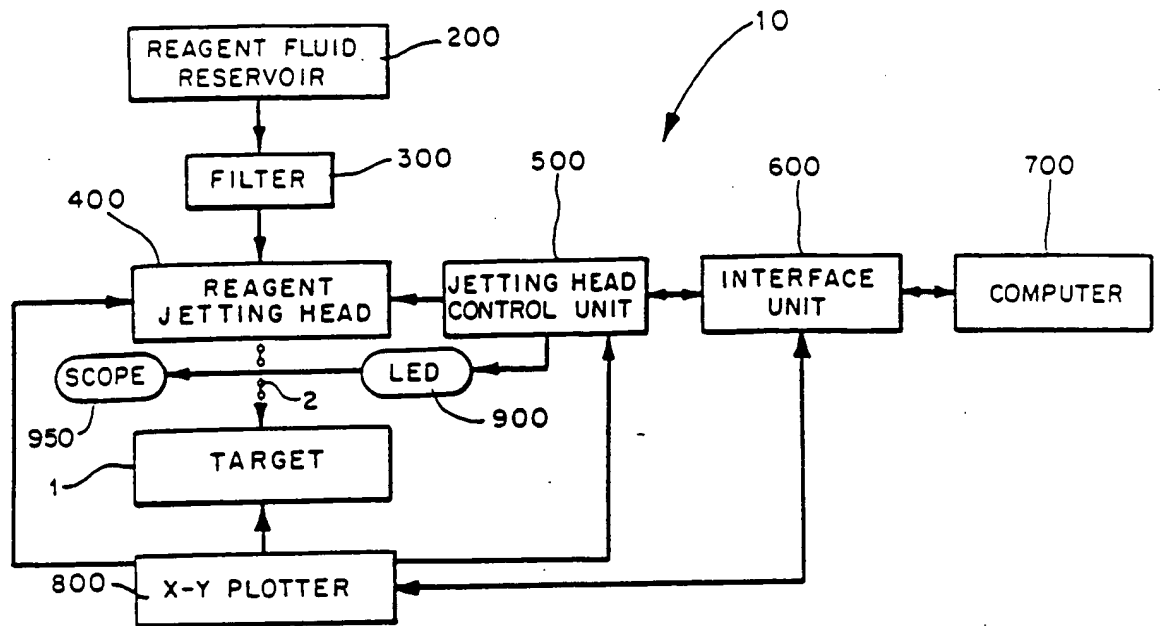


FIG. 4

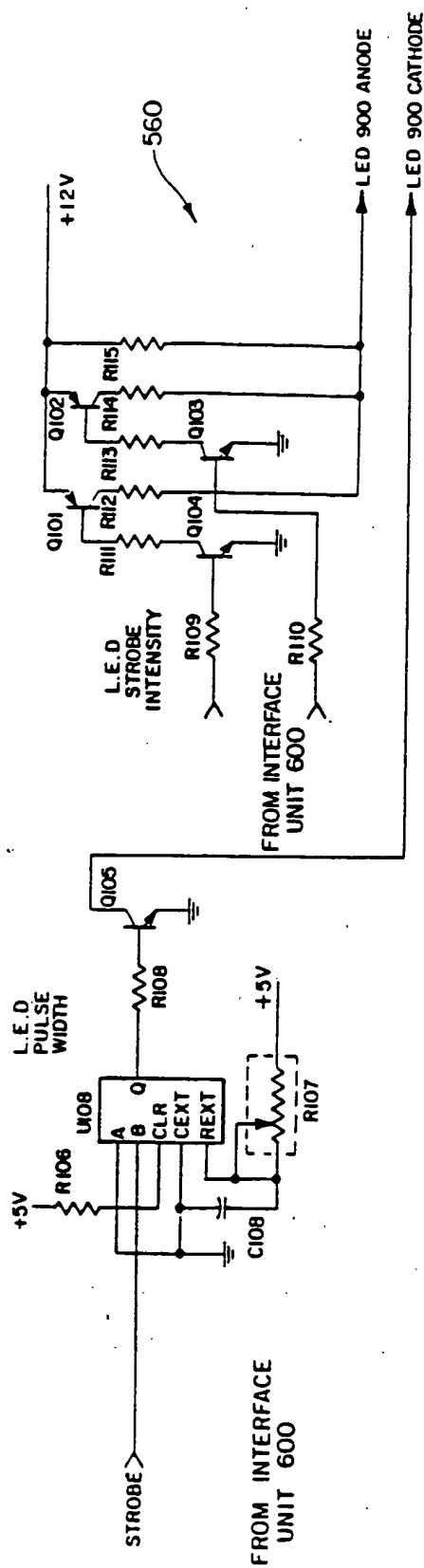


FIG. 5a

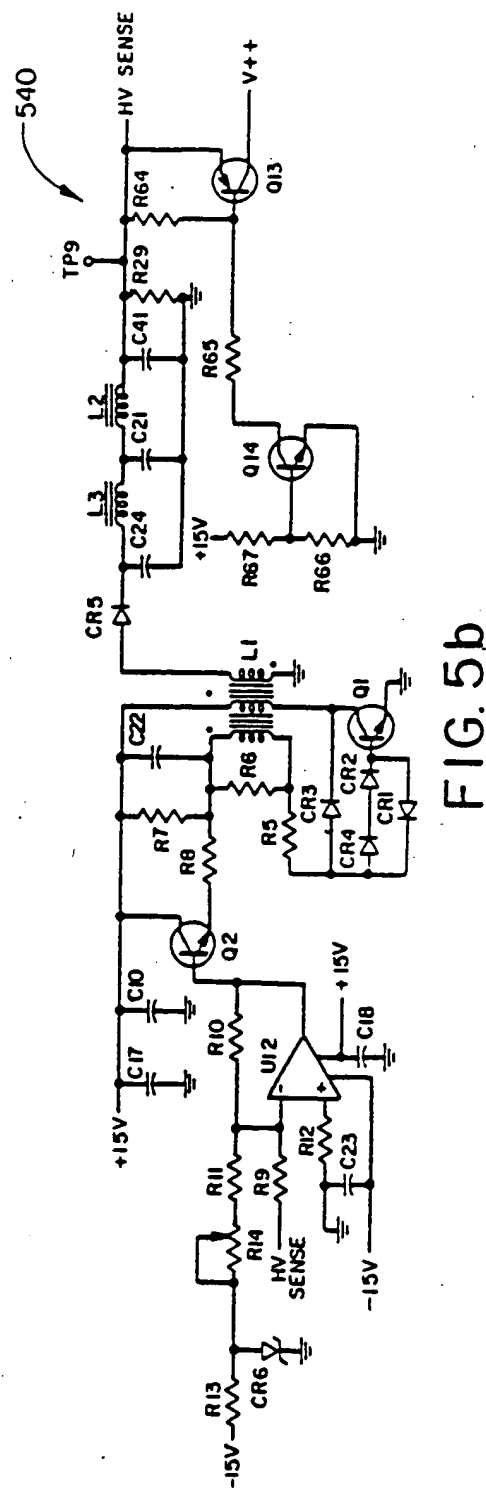


FIG. 5b

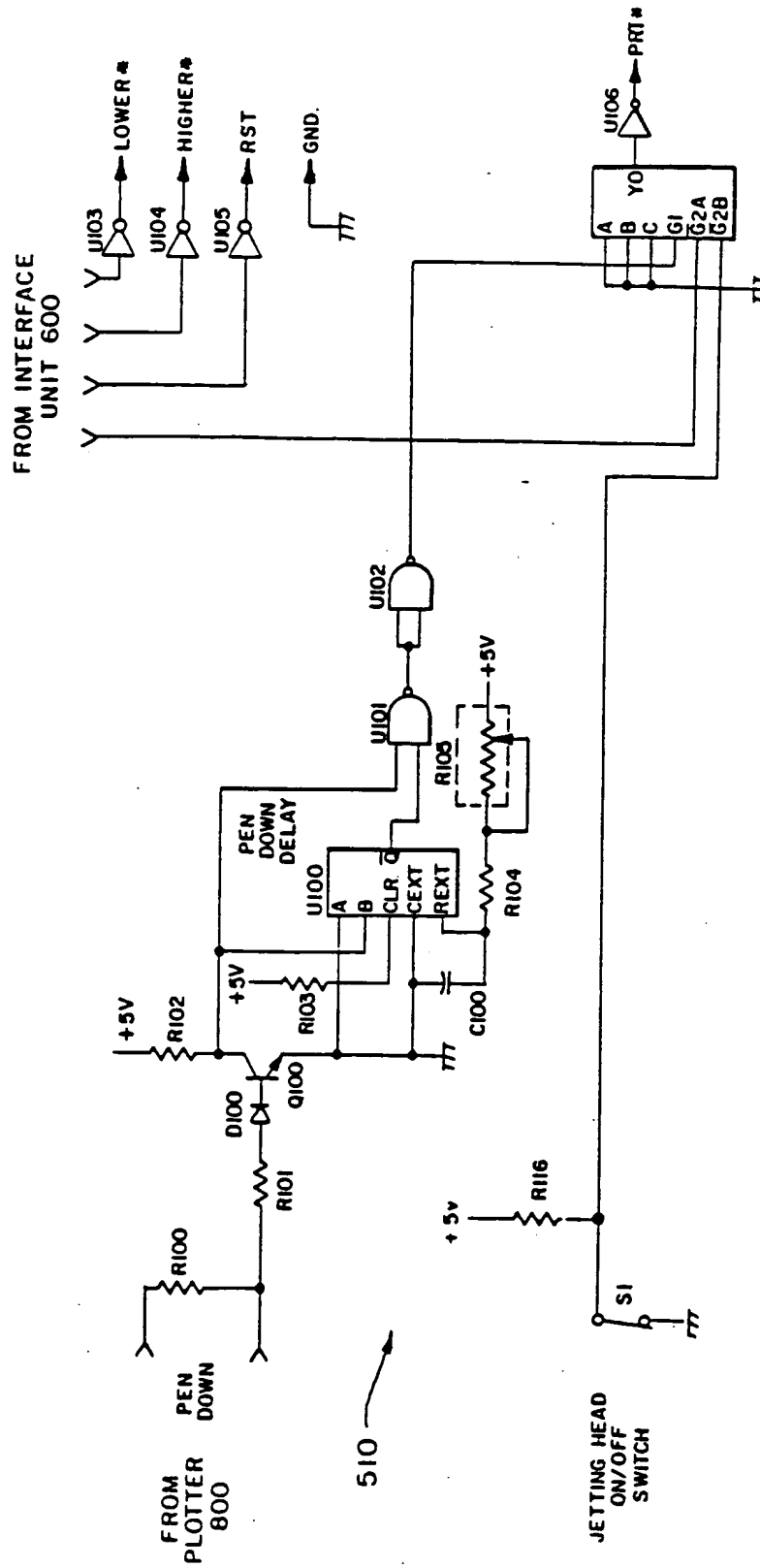


FIG. 5c

FIG. 5d

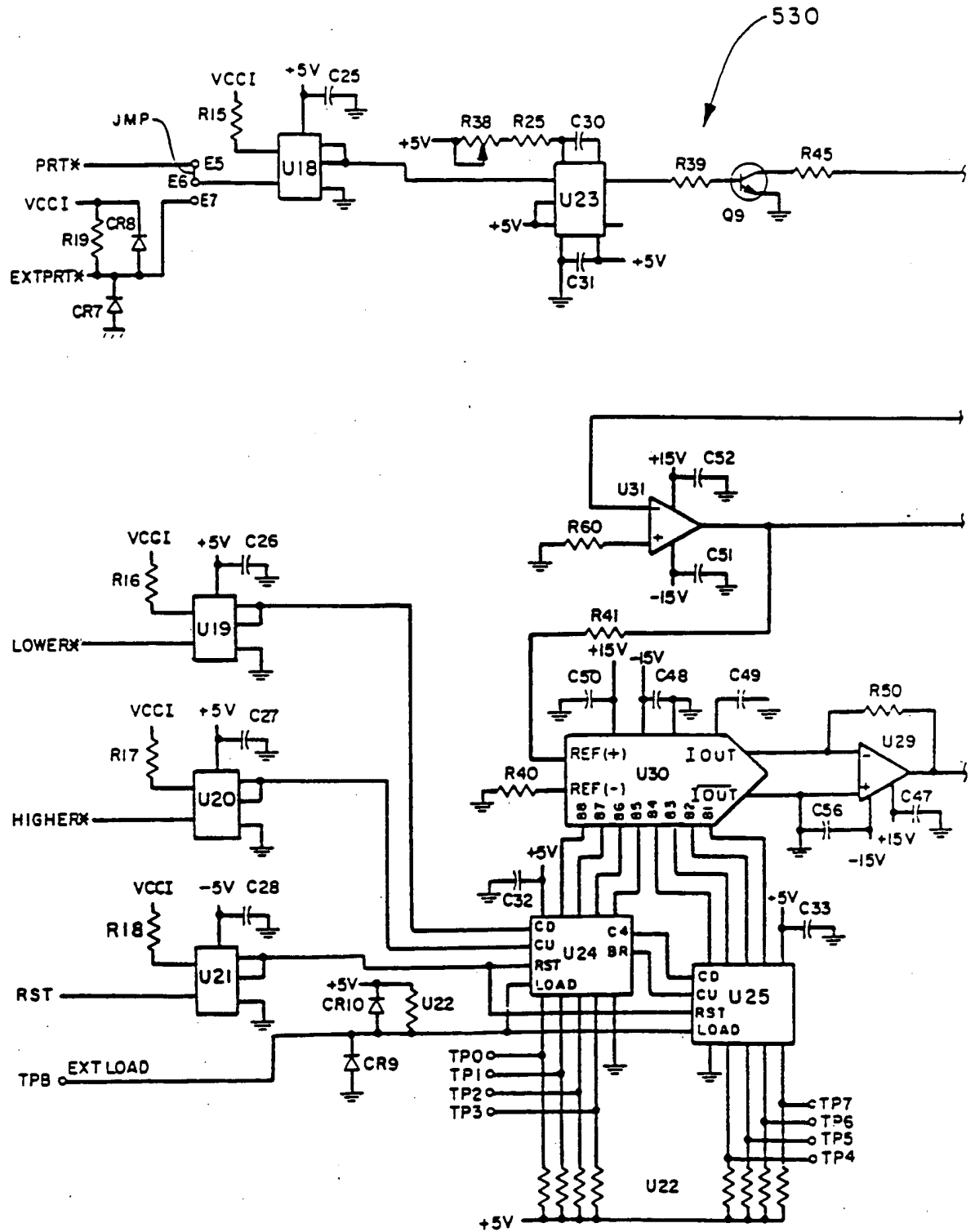


FIG. 5e

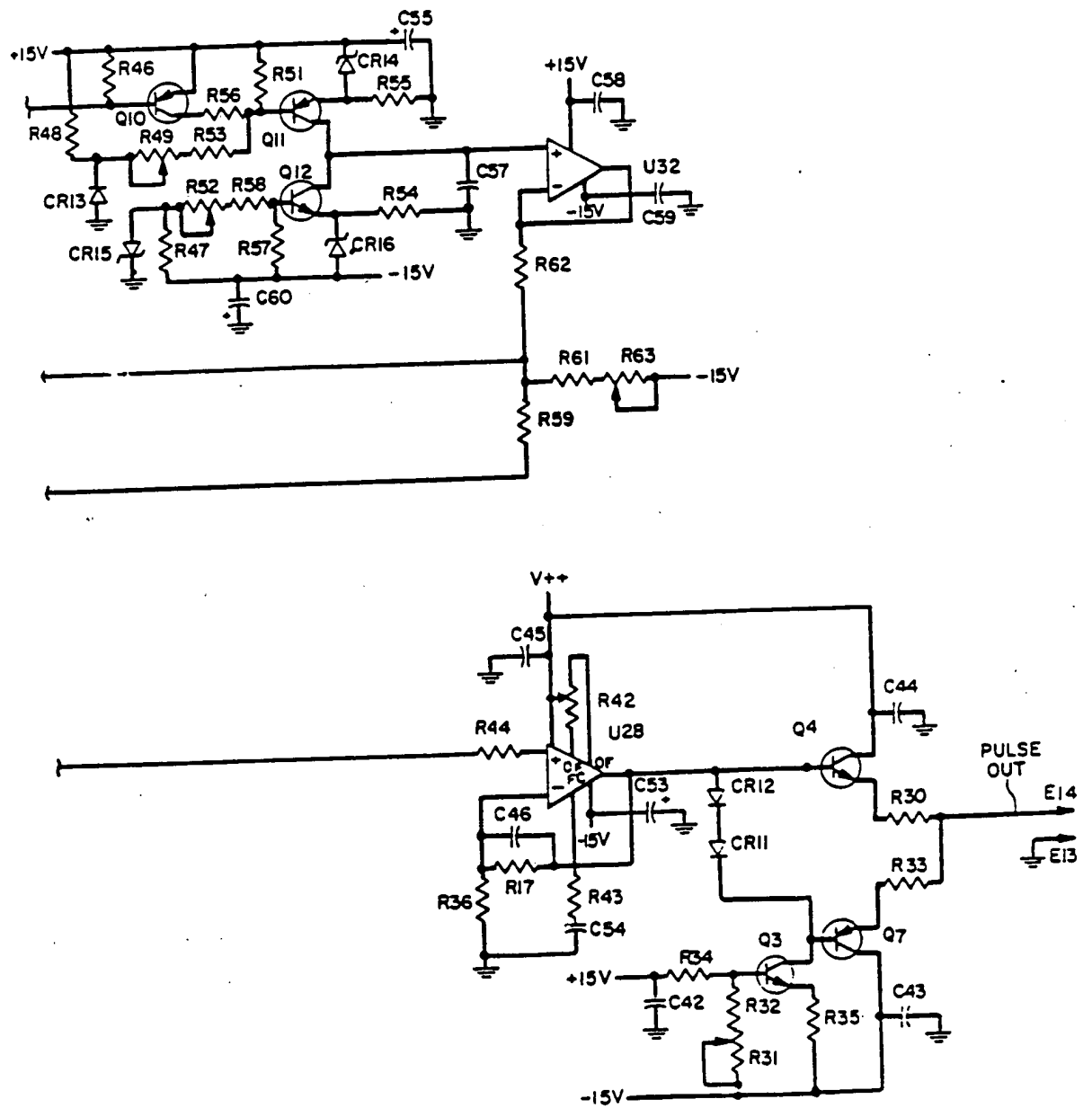




FIG. 6a

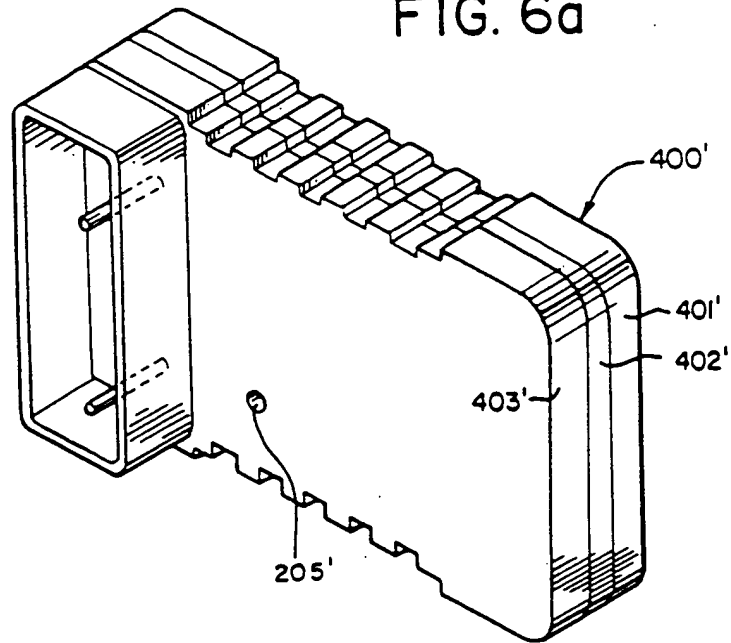


FIG. 7

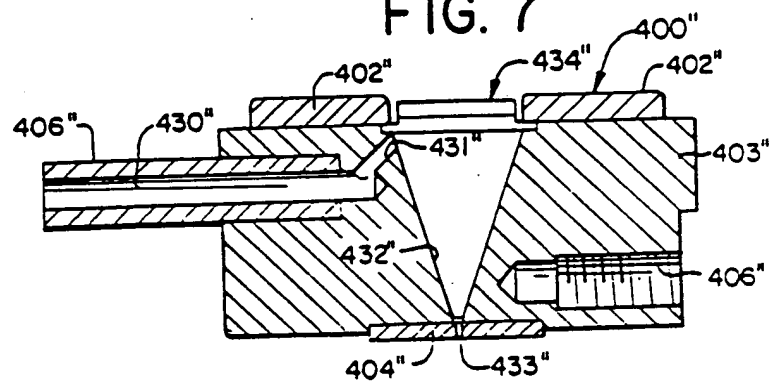
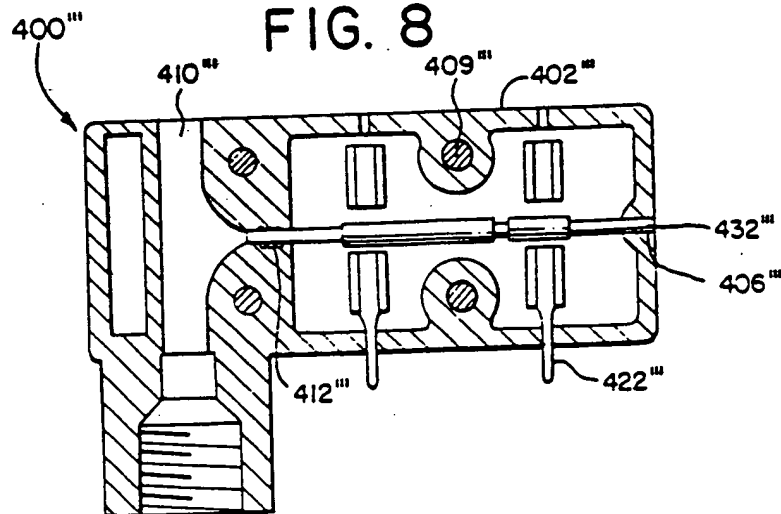
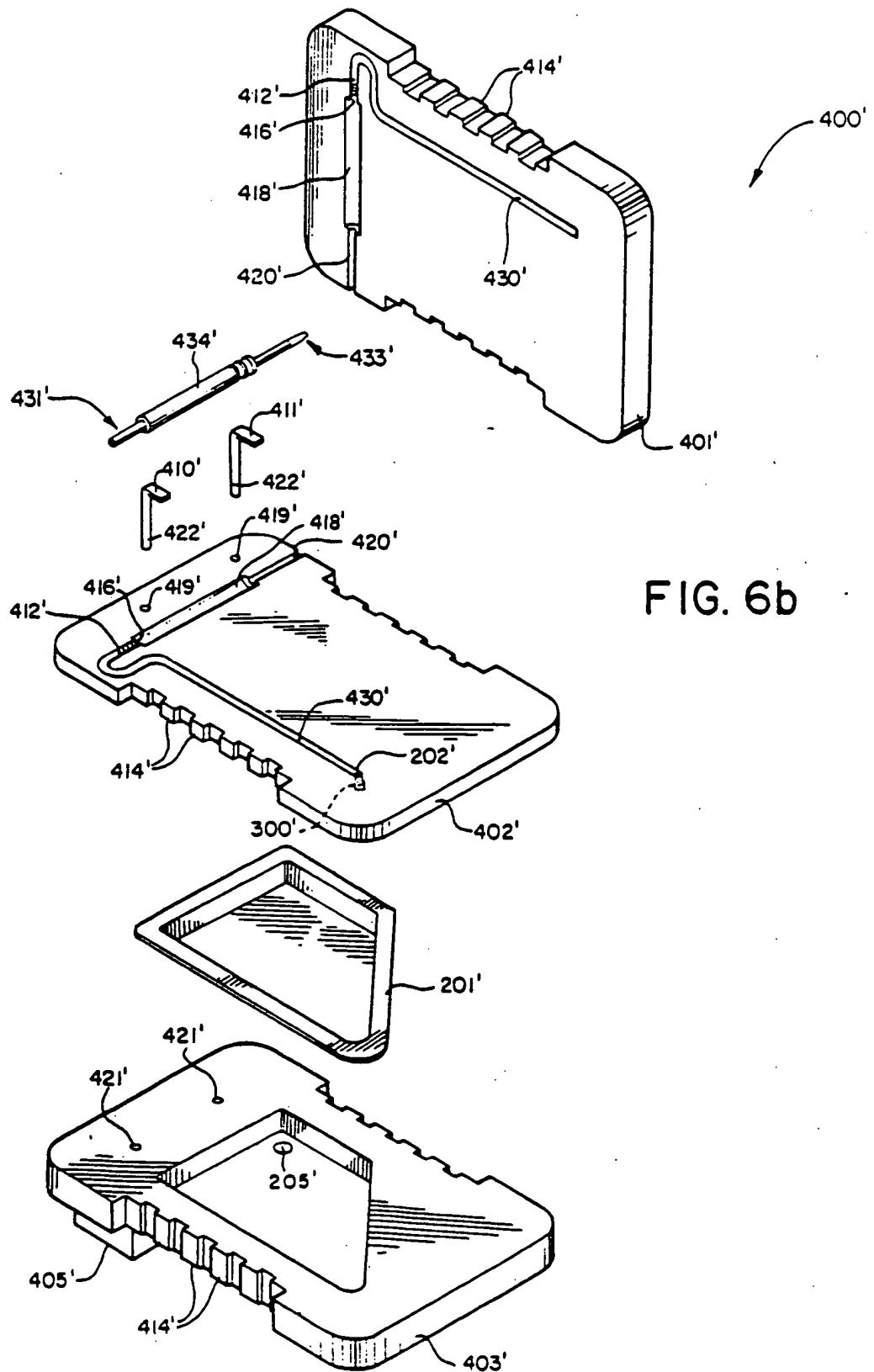


FIG. 8





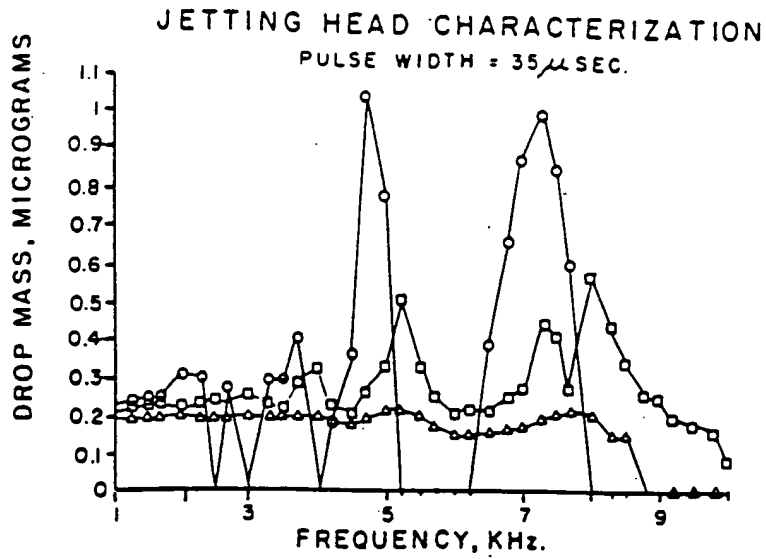


FIG. 9

□ VIS = 5 CP  
○ VIS = 1 CP  
△ VIS = 24 CP

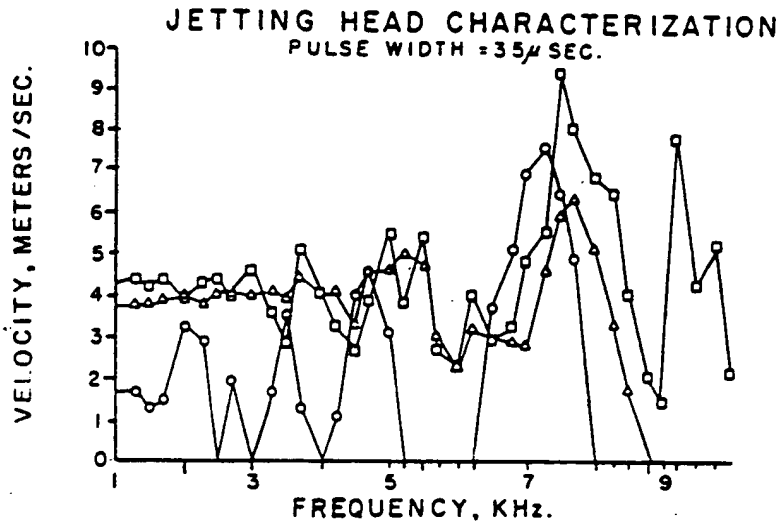


FIG. 10

□ VIS = 5 CP  
○ VIS = 1 CP  
△ VIS = 24 CP

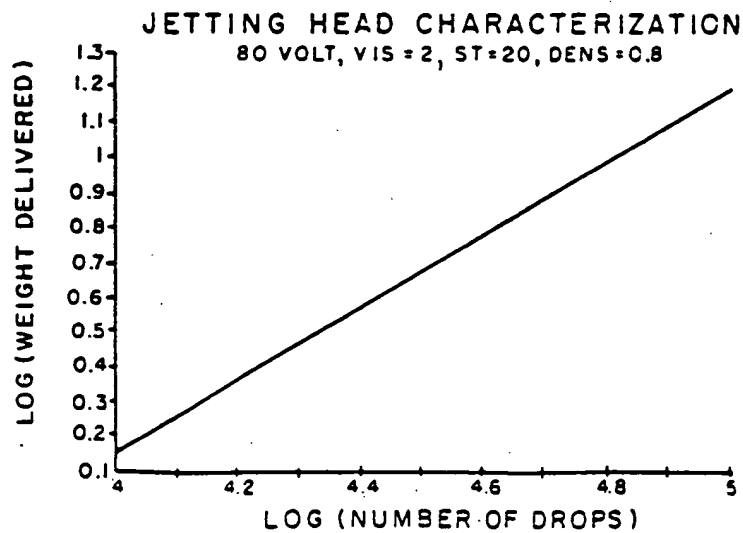


FIG. 11

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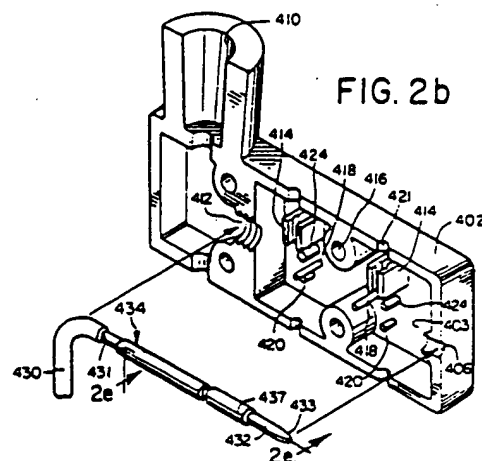
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⑤A Apparatus and process for reagent fluid dispensing and printing.

⑤A A system for printing and dispensing chemical reagents in precisely controlled volumes onto a medium at a precisely controlled location. A jetting tube (432), comprising an orifice (433) at one end and a fluid receiving aperture (431) at the other end, is concentrically mounted within a cylindrical piezo-electric transducer (434). The fluid receiving aperture (431) is connected to a reservoir (200) containing a selected reagent by means of a filter (300). The reservoir is pressurized by a regulated air supply. An electrical signal of short duration is applied to the transducer. The pulse causes the transducer (434) and the volume defined by the jetting tube (432) to expand, thereby drawing in a small quantity of reagent fluid. The cessation of the pulse causes the transducer (434) and the volume of the jetting tube (432) to de-expand, thereby causing at least a substantially uniformly sized droplet of reagent fluid to

be propelled through the orifice (433). The droplet may be directed to impact a printing medium or collected in a dispensing receptacle.





Europäisches  
Patentamt

# EUROPÄISCHER RECHERCHENBERICHT

Nummer der Anmeldung

EP 87 11 6826

EINSCHLÄGIGE DOKUMENTE			
Kategorie	Kennzeichnung des Dokuments mit Angabe, soweit erforderlich, der maßgeblichen Teile	Betrifft Anspruch	KLASSIFIKATION DER ANMELDUNG (Int. Cl.4)
A	US-A-2 459 581 (F.G. OSWALD) * Ansprüche 1,7; Seite 1, Spalte 1, Zeilen 1-33 * ---	1-8	C 08 G 63/48 C 08 G 63/66 C 09 D 3/64
A	PATENT ABSTRACTS OF JAPAN, Band 9, Nr. 119 (C-282)[1842], 23. Mai 1985; JP-A-60 8312 (DAINIPPON INK KAGAKU KOGYO K.K.) 17-01-1985 * Zusammenfassung * ---	1-4	
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